THE YUKON TERRITORY

THE YUKON TERRITORY

ITS HISTORY AND RESOURCES

ISSUED BY DIRECTION OF
THE HON. W. J. ROCHE, MINISTER OF THE INTERIOR
OTTAWA, 1916

Department of the Interior,
Mining Lands and Yukon Branch,

Ottawa, December 1, 1915.

W. W. Cory, Esq., C.M.G.,
Deputy Minister of the Interior.

Sir,—I have the honour to submit herewith a report dealing with the history and resources of the Yukon Territory.

I have the honour to be, Sir,

Your obedient servant,

H. H. Rowatt,
Controller, Mining Lands Branch,
and Secretary of the Yukon.

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PREFACE

IN the compilation of this pamphlet an effort has been made to secure as much information as possible on the subject of dredging, which has now superseded in magnitude almost every other form of profitable mining. In the chapter on dredging will be found much valuable information as to methods and costs which has not hitherto been published. Through the courtesy of Mr. O. B. Perry, Consulting Engineer and General Manager of the Yukon Gold Company, much information respecting the costs of dredging and of hydraulic mining has been obtained, also from the Resident Manager of the same Company, Mr. C. A. Thomas. Equally valuable and interesting is the information furnished by Mr. J. W. Boyle, General Manager of the Canadian Klondike Mining Company, Limited, who also gave very complete particulars on the subject of the construction of the principal parts of his Company's dredges, as well as respecting the plant and scope of operations of the Company of which he is Manager.

In the chapter on ordinary placer mining, the Gold Commissioner furnished much valuable data which gives a fairly accurate idea of the scope and character of this class of mining.

The list of fox and mink farms in Southern Yukon was compiled by the Assistant Gold Commissioner at Whitehorse. Those interested in this industry will find in the chapter on fox farming some useful information, which is re-printed from a recent publication issued by the Commission of Conservation.

Quartz prospectors who are interested in the chapter on radium-bearing minerals might obtain a copy of the Report of the Klondike Gold Fields (No. 884) by Mr. R. J. McConnell, B.A., now Deputy Minister of Mines, which describes the occurrences of pegmatite veins or dikes in the Klondike District, as well as other reports which have been issued from time to time by the Geological Branch of the Department of Mines.

Ottawa, 1st October, 1915.

THE YUKON TERRITORY

CHAPTER I.

HISTORICAL SKETCH

THE earliest explorations in the Yukon Territory must of necessity form part of the history of the Hudson's Bay Company. In 1670 this company was incorporated by Royal Charter granted by King Charles the Second to "the Governor and Company of Adventurers of England trading into Hudson's Bay" who were constituted, "the true and absolute lords and proprietors" of the territory designated as "Rupert's Land." A supplementary license was granted to the company in 1821 and this license, which was renewed on the 30th of May, 1838, conferred upon the Honourable Adventurers, the exclusive right to trade in the Indian territories west of the Rocky mountains.

On the 12th of July, 1776, Captain Cook sailed from England on a voyage of discovery in the North Pacific. In March, 1778, Cook anchored in Nootka sound. Proceeding northward he passed Sitka and on the 4th of May he saw and named Mount St. Elias. In August of the same year he entered Bering strait and traced the coast north eastward to Icy cape. He then returned and explored part of Norton sound.

In 1786, the Northwest Fur Trading Company of Montreal established a post on Lake Athabasca and three years later Alexander Mackenzie, a representative of the company, explored the great river which now bears his name. In 1792, Mackenzie again started from the post on Lake Athabasca and proceeded down the Peace river. In the spring of the following year he crossed the Rocky mountains and reached the Pacific ocean in the vicinity of Queen Charlotte sound on the 22nd of July. Prior to Mackenzie's arrival, however, Cook's midshipman, Vancouver, had already explored and surveyed the coast from latitude 35° to 60° north. In 1825, Franklin also commenced his second journey westward from the mouth of the Mackenzie. Within the period of fifteen years subsequent to 1778, British seamen had explored the islands and western coast of what is now British Columbia, and also a part of Alaska, and representatives of the fur companies had also reached both the Pacific coast and Arctic ocean.

The Russians, who explored the north coast of Siberia, were actuated more by the spirit of trade than exploration. In 1646, several small Russian vessels under the command of one, Isai Ignatief, sailed eastward from the Kolyma and reached a bay where they obtained walrus ivory by barter from the Chukchees, who inhabited that portion of Eastern Siberia east of the valley of the Anadyr river. Two years later a larger expedition commanded by Simeon Deshneff successfully rounded the northeast extremity of Asia and entered Bering strait.

In January, 1725, Peter the Great issued instructions that an expedition be equipped to obtain further information in regard to the extension of Asia and America. In 1728, Vitus Bering, a Danish navigator, who was in charge of the expedition, sailed from the mouth of the Kamchatka river and ascertained that Asia and America were separated by sea. Bering made no attempt to discover the mainland of the American continent, and returned to St. Petersburg in 1730. In the meantime, a navigator and civil engineer named Michael Gwosdeff, in charge of a Cossack expedition, sailed to the Chukchee coast. This expedition remained at Cape Serdze until a storm drove them eastward to an island beyond which they discovered the shores of the continent of America. On the 4th of June, 1741, Bering, who had been promoted to be a commander, sailed from Avatcha in search of the American coast. On the 15th of July, Chirikoff, Bering's first lieutenant, landed near Cross sound and three days later Bering anchored near a cape which he called St. Elias. Two boats were sent ashore for water, but no effort was made to explore inland. After encountering considerable hardships, Bering died during the winter of 1741. As a result of the furs which were brought back by the sailors, many Russians crossed to the American coast and the fur trade commenced with the natives. In 1781, two Russians named Ivan Golikoff and Gregory Shelikoff, formed an association to control the fur trade and established a trading post on Kadiak island. One, Alexander Baranoff, who had accompanied Shelikoff in 1783, was appointed in 1790, in charge of the settlement. In 1799, the Emperor Paul handed over the control of the Russian possessions to the Russian Fur Company and on the 25th of May of the same year a trading post was established at old Sitka, which the Russians called Fort Archangel, Gabriel Baranoff being appointed chief director and governor of the Russian colonies.

Bancroft describes the presence of the Cossacks on the Eastern coast of Siberia as follows:

"As the little sable had induced the Cossacks from the Black sea and the Volga, across the Ural mountains and the vast plains of Siberia to the shores of the Okhotsk sea and the Pacific, so now the sea-otter lures the same venturesome race out among the islands, and ice and fog banks of ocean."

In order to determine the sovereign rights of the respective countries negotiations commenced between the representatives of the governments of Russia and Great Britain. Russia claimed the North Pacific coast down to latitude 51°, but in the treaty of 1824 the boundary was fixed at 54° 40′ and in the following year a further treaty was concluded by which Russia relinquished to Great Britain her claim not only to the region below latitude 54° 40′, but also to the vast interior occupied by the Hudson's Bay Company up to the frozen ocean. Article III. of the treaty of 1825 defined the southern and western boundaries of the British possessions as follows:

"Commencing from the southernmost point of the island called Prince of Wales' island, which point lies in the parallel of 54 degrees, 40 minutes north latitude, and between the 131st and 133rd degree of west longitude (meridian

The Honourable W. J. Roche, Minister of the Interior

of Greenwich), the said line shall ascend to the north along the channel called Portland channel, as far as the point of the continent where it strikes the 56th degree of north latitude; from this last mentioned point the line of demarcation shall follow the summits of the mountains situated parallel to the coast, as far as the point of intersection of the 141st degree of west longitude (of the same meridian); and, finally, from the said point of intersection, the said meridian line of the 141st degree, in its prolongation as far as the frozen ocean, shall form the limit between the Russian and British possessions on the continent of America to the northwest."

The line of demarcation is described in Paragraph 2, Article IV. of the treaty of 1825, as follows:

"2nd:, That wherever the summit of the mountains which extend in a direction parallel to the coast, from the 56th degree of north latitude to the point of intersection of the 141st degree of west longitude, shall prove to be at the distance of more than ten marine leagues from the ocean, the limit between the British possessions and the line of coast which is to belong to Russia, as above-mentioned, shall be formed by a line parallel to the windings of the coast, and which shall never exceed the distance of ten marine leagues therefrom."

In 1867, Alaska was purchased from Russia by the United States and considerable difficulty subsequently arose as to this demarcation line, but the question was finally settled in 1903 by the award of the Alaska Boundary Tribunal.

By virtue of an act passed in 1815, the control of the territorial affairs of the Hudson's Bay Company was transferred from a committee sitting in London to a person designated as the Governor-in-Chief of Rupert's Land and his council. Five years later, Sir John Simpson, who had been a clerk in a London counting house was appointed Governor, and for a period of nearly forty years was head of the Company's fur trade and virtual ruler of almost half a continent. It was during the regime of Sir John Simpson that the Yukon territory was first explored by the Company's traders.

A trading post had been established at Dease lake, about ninety miles south of the boundary line of the Province of British Columbia. This post was abandoned in 1839 and in the spring of the following year Mr. Robert Campbell was directed by Sir George Simpson to explore the north branch of the Liard to its source, and to cross the divide in search of any river flowing to the westward.

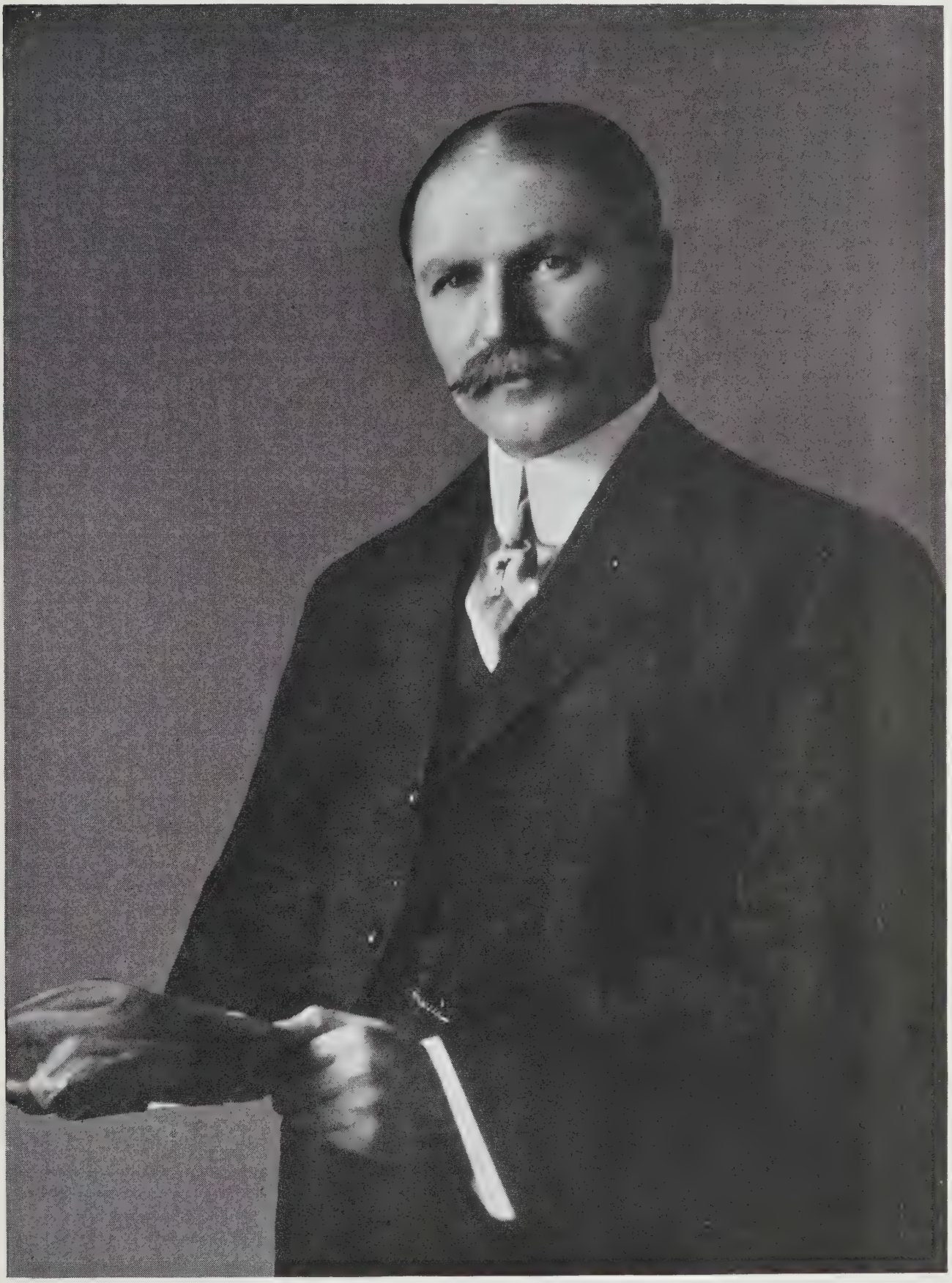
Mr. Campbell writes: 'In pursuance of these instructions, I left Fort Halkett (on the lower Liard) in May with a canoe and seven men, among them my trusty Indians, Lapie and Kitza, and the interpreter Hoole. After ascending the stream some hundreds of miles, far into the mountains, we entered a beautiful lake, which I named Frances lake, in honour of Lady Simpson. Leaving the canoe and part of the crew near the southwest (sic) extremity of this (west) branch of the lake, I set out with three Indians and the interpreter. Shouldering our blankets and guns, we ascended the valley of a river, which we traced to its source in a lake ten miles long, which, with the river, I named Finlaison's lake and river.'

Alfred Thompson, Esq., M.D., Member of Parliament for the Yukon

From this point Mr. Campbell struck across to the Pelly, which he then named in honour of Sir H. Pelly, a governor of the company. A fort was constructed at Pelly Banks in 1842, and in the following year Campbell floated down the Pelly in a birch bark canoe to the confluence of a river which he named the Lewes. This river was named by Campbell after John Lee Lewes, the chief factor of the Hudson's Bay Company. At this point was encamped a large band of 'Wood Indians' who volunteered the information that the natives on the lower river were hostile. Campbell returned to Pelly Banks where, during the winter of 1847-48, boats were built, and in the following June Fort Selkirk was established at the confluence of the Pelly and the Yukon.

In answer to inquiries on the subject by Dr. Dawson, Mr. Campbell stated that the Stewart river was discovered in 1849 and that this river was named after James G. Stewart, son of the late Hon. John Stewart, of Quebec. Stewart was Campbell's assistant clerk, and had been sent out from Fort Selkirk in the winter of 1849 to follow the Indian hunters in quest of meat. He found them some distance north of the Stewart river, which he crossed on the ice. In 1850, Campbell descended the river from Fort Selkirk to Fort Yukon, being the first white man to pass the mouth of the famous Klondike and the site of the present city of Dawson. In this year the fort at Pelly Banks was abandoned, and Campbell decided to establish the headquarters of the company at Fort Selkirk. The fur taken by the Indians to Pelly Banks could as easily be taken to Fort Selkirk, from which point they were taken to Fort Yukon and up the Porcupine to the Mackenzie. This route was considered preferable to the land transport from Pelly Banks to Frances lake and the arduous and dangerous navigation of the Liard. In 1852, however, Fort Selkirk was the scene of an unfortunate disaster, which closed Campbell's career in the Yukon. Dr. Dawson presents the facts as follows:—

'The several ruined chimneys of Fort Selkirk, still to be seen, with other traces on the ground, are in themselves evidence of the important dimensions and careful construction of this post. The establishment consisted, I believe, in 1852, of one senior and one junior clerk and eight men. The existence of this post in the centre of the inland or "Wood-Indian" country had, however, very seriously interfered with a lucrative and usurious trade which the Chilcoot and Chilkat Indians of Lynn Canal, on the coast, had long been accustomed to carry on with these people; acting as intermediaries between them and the white traders on the Pacific and holding the passes at the headwaters of the Lewes with all the spirit of robber barons of old. In 1852 rumour was current that these people meditated a raid upon the post, in consequence of which the friendly local Indians stayed by it nearly all summer of their own accord. It so happened, however, that they absented themselves for a couple of days, and at that unlucky moment the coast Indians arrived. The post was unguarded by a stockade, and yielding to sheer force of numbers the occupants were expelled and the place was pillaged, on the 21st of August. Two days afterward Campbell, having found the local Indians, returned with them and surrounded the post, but the robbers had flown.



George Black, Commissioner of the Yukon Territory

Being now without means of support for the winter, Campbell set off down stream to meet Mr. Stewart and the men who were on the way back from Fort Yukon. He met them at the mouth of White river, and after turning them back with instructions to arrange for wintering at Fort Yukon, set out himself in a small canoe up the Pelly river, crossed to Frances lake, descended the Liard and arrived at Fort Simpson with the tidings of the disaster, amid drifting ice, on the 21st of October.

'Being anxious to obtain Sir George Simpson's permission to re-establish Fort Selkirk, Campbell waited only until the river froze, when he left Fort Simpson on snowshoes and travelled overland to Crow Wing, in Minnesota, where he arrived on the 13th of March. On the 18th of April he reached London, but was unable to obtain from the directors of the company the permission he desired.

'In the autumn of 1853 one of Campbell's hunters arrived at Fort Halkett, on the lower Liard, by way of the Pelly and Frances. This is the last traverse of Campbell's portage of which I can find any record, though it may doubtless have been used by the Indians subsequently. From this man it was learnt that the buildings at Fort Selkirk had been all but demolished by the local Indians for the purpose of getting the ironwork and the nails. He also stated that the Chilkats, being unable to carry away all their plunder in the preceding year, had taken merely the guns, powder and tobacco. They had cached the heavier goods, which were afterwards found and appropriated by the local or Wood Indians.'

This remarkable journey, which was made by Campbell from Fort Selkirk to London, a distance of about 9,700 miles, over three thousand of which he travelled on snowshoes in the dead of winter through a practically uninhabited wilderness, is a splendid testimony of the intrepid spirit and determined character of those adventurous traders. In the history of the west, the name of Campbell may well be classed with such explorers as Mackenzie, Thompson, and Fraser, whose services in the cause of commerce have done so much to open up the wonderful resources of the western portion of the Dominion. Civilization is indebted to these men not only on account of their remarkable daring in face of the enormous difficulties which they overcame, but for their straightforward dealings with the Indians. 'Their journeys were not marked by incidents of conflict or bloodshed, but were accomplished, on the contrary, with the friendly assistance and co-operation of the natives.'

The Peel river was named by Sir John Franklin in honour of Sir Robert Peel, and the information furnished by Franklin concerning the fur bearing animals along this river induced the Hudson's Bay Company to send an exploration party under Mr. J. Bell who was directed to make an examination of the locality preparatory to establishing a trading post. During the summer of 1839, Mr. Bell explored the river to the head of the Snake river, and the following year Fort McPherson was established at the head of the delta. In 1842, Bell made a three days' journey down the Porcupine. Four years later he reached the mouth of the Porcupine and saw the great river into which it flows, which the Indians

Dawson, Y. T., Panoramic View

informed him was named the Yukon. In 1847 Fort Yukon was established at the mouth of the Porcupine by Mr. A. H. Murray.

Gold had been discovered in the Yukon by Campbell and other traders in the service of the Hudson's Bay Company. It was not until 1872, however, that regular prospectors began to direct their steps toward the Yukon. In September of that year Arthur Harper, a native of County Antrim, Ireland, together with Frederick Harper and four other miners started for the Mackenzie river and the Yukon Territory. At the mouth of the Nelson, Harper and his party met L. N. (Jack) McQuesten, Alfred H. Mayo and James McKnipp. Proceeding by way of the Mackenzie river, Harper and his party crossed from Fort MacPherson to the Porcupine and arrived at Fort Yukon on the 15th of July, 1873.

When Alaska was purchased from Russia by the United States, the Russian company's vessels and trading posts were acquired for the firm of Hutchinson, Kohl & Co., San Francisco. In 1869, the Alaska Commercial Company was incorporated and three years later this company purchased the holdings of Hutchinson, Kohl & Co. In 1901 the Alaska Commercial Company merged with the Alaska Exploration Company and the name of the joint concern became the Northern Commercial Company.

The Alaska Commercial Company established posts along the Yukon River and for many years subsequent to the retirement of the Hudson's Bay Company had a monopoly of trade in the Yukon. In 1892 a competing company known as the North American Transportation and Trading Company was organized in Chicago. This company established its chief trading and distributing post at Cudahy, a short distance below the mouth of the Forty Mile river.

In 1874, Jack McQuesten established a trading post for the Alaska Commercial Company at Fort Reliance about six miles below the present city of Dawson. In the same year Harper joined McQuesten in the trading business and in 1875, Harper and Mayo were in charge of Fort Reliance.

In 1885 mining commenced on the Stewart river and in the following year Harper, McQuesten and Mayo, who were trading on commission for the Alaska Company, established a trading post at the mouth of the Stewart. Shortly after the discovery of gold on the Fortymile in 1887 they also established another trading post at the mouth of the Fortymile river. Harper also commenced business at Fort Selkirk, on the site of the old post which was first established by Campbell, and built a new post at Ogilvie opposite the mouth of the Sixtymile river. During this time, Harper had prospected for gold in the Fortymile, Sixtymile and Tanana districts, and for copper in the White River district, but was not particularly successful in his mining operations.

Discovery of the Klondike

In the summer of 1882 twelve miners crossed Dyea pass and spent the winter at Fort Reliance. One of these miners was Joe Ladue who later became identified with the development of the territory and who subsequently occupied the

Administration Building, Dawson, Y.T.

trading post at Ogilvie. In 1886 about 100 miners were rocking bars along the Stewart river, the average per man for the season, according to Mr. Ogilvie being about $100 per day. In the autumn of 1886 coarse gold was discovered in the Fortymile river, and as soon as the news of the discovery reached the Stewart the usual stampede occurred. In this year the number of miners in the Yukon basin may be stated at 250, there being 200 on the Fortymile and about 50 on the Stewart.

In 1894 Robert Henderson, of Nova Scotia, and a small party arrived in the territory. They prospected along the bars of the upper Yukon and rocked out $54.00 in fine gold at the mouth of the Pelly. When they reached the trading

Commissioner's residence, Dawson

post at Olgivie, Joe Ladue contributed the latest information respecting the strikes or discoveries which had been made. As a result of the information furnished by Ladue and after a short stay at Olgivie, Henderson started for Indian river. He prospected along this stream to the mouth of what is now known as Quartz creek, up which he proceeded to the divide on Hunker. No large prospects were found, and Henderson returned to Ogilvie for provisions. During the following year Henderson prospected on various creeks in the Watershed of Indian river. After cleaning up about $600.00 for the season on Quartz creek he crossed the divide to Gold Bottom where he found a two cent prospect. During the summer of 1896 Henderson made a trip to Ladue's post at Ogilvie for supplies. The water in Indian river was low and he knew that it would be almost impossible to proceed up that stream. He came to the conclusion that Gold Bottom flowed into a tributary of the Yukon some distance below Ogilvie

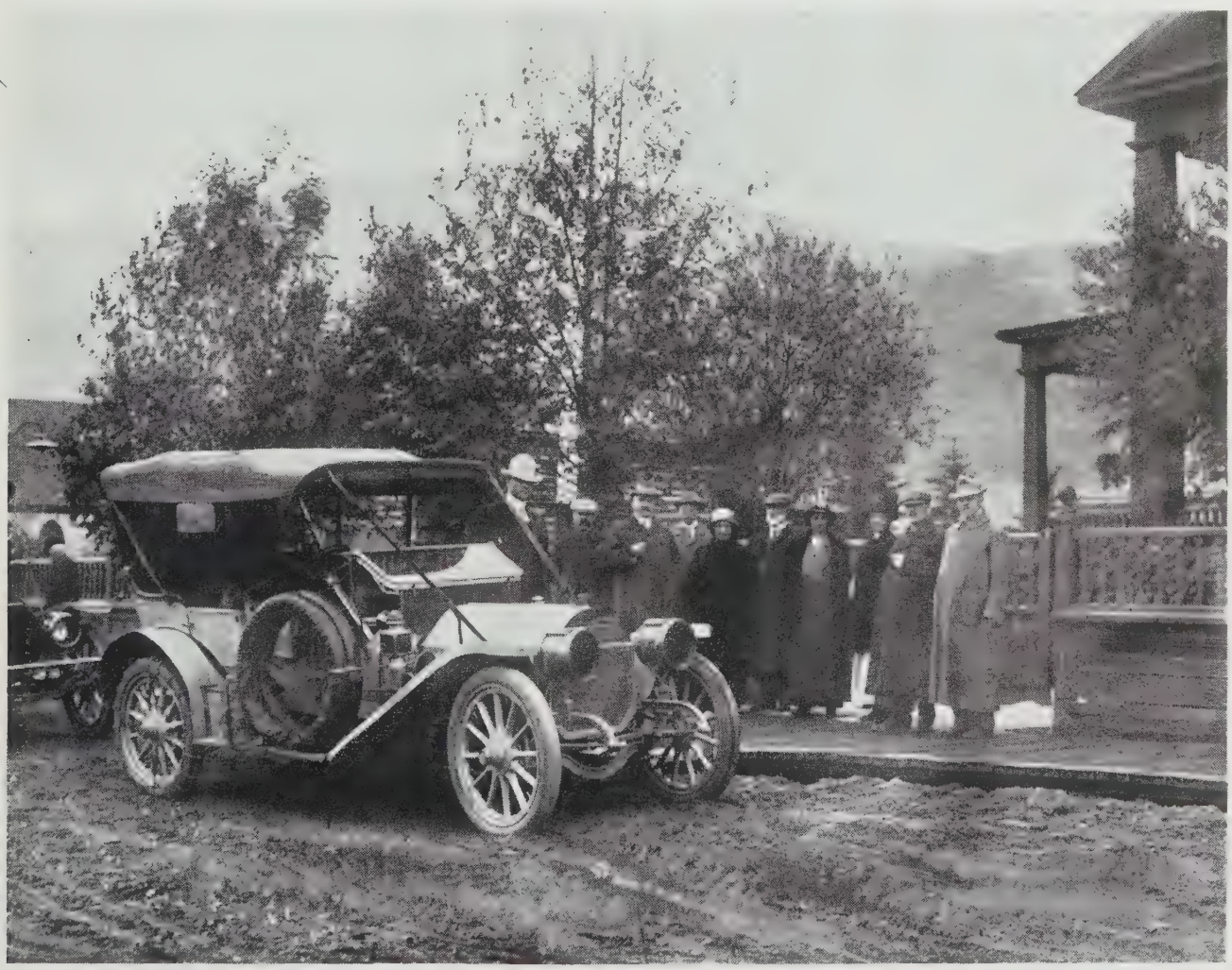
so he proceded down the Yukon to its confluence with the Tron Deg, which is the Indian name for the Klondike, where he found George W. Carmack and two Indians named "Skookum Jim" and "Tagish Charlie," who were fishing for salmon. In accordance with the usual custom Henderson announced the discovery he had made, and invited Carmack to stake on Gold Bottom. A short time afterwards Carmack and the two Indians proceeded to Gold Bottom and staked claims near to where Henderson and his party were working. Henderson states that he advised Carmack and the Indians to cross the divide and prospect in the gravels of what is now known as Bonanza creek. He asked Carmack to advise him, by sending back an Indian, if good prospects were discovered.

As a result of this trip rich prospects were discovered on Discovery Claim, which Carmack staked as well as No. 1 below. "Tagish Charlie" staked No. 2 below and "Skookum Jim," the other Indian, No. 1 above. Carmack and the Indians at once proceeded to Fortymile and filed their applications with the recorder for the district. Up to this time the majority of the miners in the territory had been working on Fortymile, but as soon as the discovery on Bonanza became known all the miners in the Fortymile district stampeded to the new strike and in a short time Bonanza creek was staked from end to end. Meantime, Henderson and his party were working on Gold Bottom, and did not hear of the new strike until all the creek had been staked. Extensive prospecting at once commenced at Bonanza, and in a few months was revealed the remarkable wealth contained in the gravels of Bonanza and Eldorado creeks.

As soon as the news of the rich strike reached the outside world, thousands of gold seekers immediately started for the Klondike. Probably never before in the history of gold mining camps has there been such a rush of people from almost every country in the world and of almost every vocation in life, as was seen in that irresistible stream of fortune-seekers, who climbed the Chilkoot pass and pressed on to lake Lindeman, where the most primitive boats and other flimsy craft were hastily constructed for the journey of 500 miles down the Yukon river to Dawson. One of the saddest events in the history of this great stampede occurred one morning on the trail between the summit of the Chilkoot pass and Sheep Camp. For some distance between these two points the trail leads along the bottom of a steep mountain, and a long line of gold seekers were laboriously toiling along this stretch of the journey, some bearing their heavy burden of supplies in packs and some on sleds, when suddenly a huge mass of snow came plunging down the mountian side, striking the line of travellers and burying between 50 and 60 men. Those who escaped the avalanche at once commenced to dig for their comrades, very few of whom were rescued, and some of the bodies were not recovered until the snow disappeared in the spring. Such is an instance of the dangers which confronted in the early days the thousands of adventurers who contracted the gold fever, and who were unaware of the innumerable hardships and dangers to be encountered and the obstacles to be overcome, on the journey to the new diggings.

As soon as the gold seekers began to arrive they at once staked claims and by the spring of 1899 all the creeks of any importance in the Klondike had been staked. There was no time to prospect: as it was assumed that the other creeks in the district were as rich as Bonanza, and that it was only necessary to acquire a claim in order to obtain a fortune. Those who had little or no experience staked hill and bench claims to the amusement of the more experienced miners, who considered that it was ridiculous to think of ever locating a pay streak at such an elevation. A story is told of a Swede, who had been imbibing too freely at Fortymile and who was induced by two old prospectors to buy a hill claim on Eldorado for $600, his whole savings. Next morning the Swede awoke repentant, and begged that his money be returned, but his appeal was of no avail. He travelled all the way to his claim, commenced to dig; reached bed rock, and found a fortune. In this way the famous White Channel gravels were discovered.

Between 1898 and 1905 upwards of $100,000,000 were taken from the placers of Bonanza, Eldorado, Hunker, Dominion, Sulphur and their tributaries. Many of the famous creek claims on Bonanza and Hunker are now being worked by the dredging process, and the terraces of the equally famous White Channel are being washed down by hydraulic methods.



Hon. J. D. Hazen and party leaving Government house, for trip to creeks

CHAPTER II.

CONSTITUTION AND GOVERNMENT

IN 1894 a detachment of the Northwest Mounted Police had been sent to the Yukon under the command of Inspector Constantine, who was authorized to represent all the different departments of government in the district. In the following year the mining industry had grown to such proportions that Inspector Constantine was no longer able to handle all the business he was called upon to transact, and an officer was appointed to take charge of the customs. In the following year a gold commissioner was appointed, and the recording office was removed from Fortymile to the site of the present city of Dawson.

In 1898 the Yukon was created a Territory by an Act of Parliament, and provision was made for local government by a legislative council composed of the commissioner and six persons to be appointed by the Governor in Council.

By Chapter 37, 2 Edward VII., provision was made for the election of a member to represent the Yukon Territory in the House of Commons of Canada, and on the 2nd of December, 1902, James H. Ross (now the Honourable), who had resigned the commissionership, was elected the first member of Parliament.

The Act was further amended in the year 1908, Chapter 76 of 7-8 Edward VII., so as to provide for a wholly elective Council of ten members, to hold office for a term of three years and to be convened by the Commissioner at least once in every year. This Council to sit separately from the Commissioner and to present bills passed by it for the Commissioner's assent. This amendment came into effect on the 1st day of May, 1909.

Alfred Thompson, Esq., M.D.,M.P., is now the federal representative of the Territory in the House of Commons.

During a period of nearly seventeen years Dr. Thompson has resided in Dawson, the capital of the Territory, and practised his profession there. He was first elected a member of the House of Commons in 1904, and has, during his long term of office, been a material force in the administration of the Territory, and in the enactment of wise legislation affecting mining, which is its primary industry.

Placer claims are held under the provisions of the Yukon Placer Mining Act, a statute of the Dominion House of Commons, while all other classes of mineral rights are administered under the provisions of Orders-in-Council passed by the Government of Canada.

The Yukon Territory Act provides for the appointment of a chief executive officer to be styled and known as the Commissioner of the Yukon Territory. An administrator may also be appointed to execute the office and functions of

Whitehorse, Y.T.

the Commissioner during his absence or illness or other inability. The Commissioner shall administer the government under instructions from time to time given him by the Governor in Council or the Minister of the Interior. By an order in council of the 7th July, 1898, the Commissioner has power to suspend any official for neglect of duty or misconduct in his discretion and to replace such official temporarily pending a decision by the minister of the department to which the suspended officer is attached.

The Yukon Council is composed of ten members elected to represent the electoral districts in the Territory. There are five electoral districts and two members are elected for each district. Any person who is qualified to vote is eligible for election as a member of the Council. All natural born or naturalized British subjects of the full age of 21 years and who have resided in the Territory for a period of twelve months prior to the date of election, shall be entitled to vote.

Every Council shall continue for three years from the date of the return of the writs for the general election, but the Commissioner may dissolve the Council and cause a new one to be elected. The Council shall be convened at least once in every year after the first session thereof. The indemnity to each member of the Council shall not exceed $600.

The Yukon Placer Mining Act

The Commissioner may divide or change the boundaries of mining districts by proclamation. The Gold Commissioner shall have jurisdiction within such mining districts as the Commissioner directs. Mining recorders shall be appointed in each mining district and shall possess all the powers and authority of a mining inspector, who shall have jurisdiction within such mining districts as the Commissioner directs.

Provision is made for the appointment of boards of arbitrators to settle disputes between owners of claims with respect to (*a*) the distribution of water, (*b*) boundaries of claims, (*c*) dumping privileges, and (*d*) overflow of water upon adjoining property. The board of arbitrators is appointed as follows: one arbitrator to be appointed by each of such owners, and, in the event of the total number of arbitrators so appointed being an even number, then an additional arbitrator shall be selected and appointed by all of such arbitrators appointed by the owners. In the event of the arbitrators appointed by the owners being an even number and being unable to agree upon the additional arbitrator, the Gold Commissioner, upon being requested so to do by such arbitrators, or by any of the interested owners, shall appoint the additional arbitrator. The judgment of the board shall be final as to facts but may be appealed from to the Territorial Court on any question of law.

The Supreme Court of Record is the Territorial Court which is presided over by a single Judge. It has civil and criminal jurisdiction.

The Court of Appeal for British Columbia is a Court of Appeal for the Territory.

For the purpose of Part *XIX.* of the Criminal Code the Court of Appeal from the judgment of the Territorial Court shall be the Supreme Court of Canada.

For the purpose of Part *XIX.* of the Criminal Code the Court of Appeal from the judgment of a Police Magistrate in the case where his jurisdiction is dependent upon the provision of the said Part with respect to Police Magistrates of cities and incorporated towns, shall be the Territorial Court, and there shall be an appeal from the Territorial Court to the Court of Appeal of British Columbia.

In the Territory the appeal from a summary conviction or order under Part *XV.* of the Criminal Code, shall be to a Judge of the Territorial Court sitting without a Jury at the place where the cause of the information or complaint arose, or the nearest place thereto where a Court is appointed to be held.

When, under the provisions of the Dominion Controverted Elections Act, two judges are required for the trial of an election petition in the Yukon Territory, or for the hearing of a special case under the said Act, such Judges shall be the Judge of the Territorial Court and a Judge of the Court of Appeal of British Columbia, or of the Supreme Court of British Columbia, or two Judges of the said Courts of British Columbia, or either of such Courts, and every such Judge shall, for the purposes of the said Act, have all the powers of a Judge of the Territorial Court.

Under Chapter 21 of the Consolidated Ordinances of 1914, the Commissioner may refer to the Territorial Court for an opinion upon constitutional or other territorial questions. The decision of the Court, although advisory only, shall, for purposes of appeal, be treated as a final judgment of the court between parties.

The commissioner, members of council and the judge of the Territorial Court, and every commissioned officer of the Royal Northwest Mounted Police, can exercise in the Yukon Territory all the powers of one or two justices of the peace, under any laws or ordinances, civil or criminal, in the Territory. All persons possessing the powers of two justices of the peace can act as coroners.

Superintendent J. D. Moodie of the Royal Northwest Mounted Police is Immigration Inspector-in-charge at the port of Dawson and has authority to exercise the powers and discharge the duties of a Board of Enquiry in accordance with the provisions of Section 22 of the Immigration Act.

Passengers or other persons seeking to enter or land in Canada from Alaska via the Lower River are examined in accordance with the provisions of the Immigration Act at the port of Dawson, and an Immigration officer also examines all passengers travelling via the White pass and Yukon railroad. During the winter season, a non-commissioned officer of the Royal Northwest Mounted Police is appointed an Immigration officer at Fortymile.

Grain on Hunker creek

CHAPTER III.

MINING—GENERAL CONDITIONS

STAKING PLACER CLAIMS.—All claims must be as nearly as possible rectangular in form, and marked by two legal posts firmly fixed in the ground. The line between the posts must be well cut out, so that one post may, if the surface of the ground will permit, be seen from the other. One of the flatted sides of each post must face the claim and on each post must be written on the side facing the claim a legible notice stating the name or number of the claim, or both if possible, its length in feet, the date when staked, and the full Christian and surname of the locator. The posts, which are numbered 1 and 2 respectively, must not be moved except No. 2, which may be moved by a Dominion land surveyor if the distance between the posts exceeds the length prescribed by the Act, but not otherwise.

(*a*) *Creek Claims.*—On creek claims the posts must be fixed in the ground on the base line at each end of the claim. Creek claims must not exceed 500 feet in length measured along the base line established or to be established by government survey. The rear boundaries of the claim shall be parallel to the base line, and shall be defined by measuring one thousand feet on each side of such base line. If the base line has not been established, the claim may be staked along the general direction of the valley of the creek, but when the base line is established, the boundaries thereby defined shall be conformed to.

(*b*) *Other Claims.*—A claim situated elsewhere than on a creek must not exceed five hundred feet in length parallel to the base line of the creek toward which it fronts, by one thousand feet. A claim fronting on a creek or river must be staked as nearly as possible parallel to the general direction of the valley of the creek or river, and shall conform to the boundaries which the base line, when established, shall define.

(*c*) *Discovery Claims.*—Any person locating the first claim on any creek, hill, bench, bar or plain, or locating a claim on any creek, hill, bench, bar or plain upon which there is no recorded claim, is entitled to a claim fifteen hundred feet in length. If, however, there are two locators, they shall be entitled to two claims, each of twelve hundred and fifty feet in length, but if there is a party consisting of more than two locators, they shall be entitled to two claims each of one thousand feet in length, and for each member of the party beyond two, a claim of the ordinary size only.

MINERAL CLAIMS STAKING.—Any person eighteen years of age or over, who has discovered mineral in place, may locate a claim not exceeding 1,500 feet in length by 1,500 in breadth. A mineral claim shall be marked by two legal

Ice jam on the Klondike

posts placed as near as possible on the line of the lode or vein, and the posts must be numbered 1 and 2. Upon each post shall be written the name of the claim, the Christian name and surname of the locator, and the date of location. Upon post number 1 shall also be written the words "Initial post," the approximate compass bearing to post number 2 and a statement of the number of feet lying to the right and to the left of the line from post 1 to post 2. The locator shall also place a legal post at the point where he has discovered mineral in place which shall be marked "Discovery post."

GRUB-STAKING.—To "grub-stake" a prospector is to furnish him with an outfit and provisions on condition of participating in the profits of his discovery.

(*a*) *Placer Claims.*—Under the Yukon Placer Mining Act any person, upon satisfying a mining recorder that he is about to undertake a bona fide prospecting trip, may receive written permission from the mining recorder, to record a claim within his mining district at any time within a period not exceeding six months from the date of staking. If the person who undertakes such bona fide prospecting trip files with the mining recorder a power of attorney, from any number of persons, not exceeding two, authorizing him to stake claims for them in consideration of their having enabled him to undertake the trip, he may stake one claim in the name of each such person upon any creek on which he makes a discovery.

(*b*) *Mineral Claims.*—Under the regulation for the disposal of quartz mining claims any person upon satisfying the mining recorder that he is about to undertake a bona fide prospecting trip may receive written permission to record a claim at any time within a period not exceeding six months from the date of staking. If the person who undertakes such bona fide prospecting trip files with the mining recorder a power of attorney, from any number of persons, not exceeding two, authorizing him to stake claims for them in consideration of their having enabled him to undertake the trip, he may stake one claim in the name of each such person upon any lode or vein which he may discover.

No person shall be entitled to hold in his own name or in the name of any other person, more than one mineral claim on the same vein or lode, or within a distance of one-half mile, except by purchase, but such person may hold by location a claim upon any separate vein or lode.

RECORDING.—(*a*) *Placer Claims.*—An application for a placer claim shall be filed with the mining recorder within ten days after location if the claim is located within ten miles of the mining recorder's office, and one extra day is allowed for every additional ten miles or fraction thereof.

(*b*) *Mineral Claims.*—An application for a mineral claim shall be recorded with the mining recorder within fifteen days after the location if the claim is located within ten miles of the office of the mining recorder, and one additional day shall be allowed for every additional ten miles or fraction thereof.

REPRESENTATION.—(1) *Placer Claims.*—A recorded owner of a placer claim has absolute right of renewal from year to year upon payment of the

renewal fee, provided such owner does, or causes to be done, work on the claim to the value of $200.00 in accordance with the following schedule:

SCHEDULE OF REPRESENTATION WORK UNDER SECTION 41 OF THE YUKON PLACER MINING ACT

Shaft Sinking

For first ten feet in depth, $2.00 per running foot of dirt removed.
For second ten feet in depth, $4.00 per running foot of dirt removed.
For third ten feet in depth, $6.00 per running foot of dirt removed.
For fourth ten feet in depth, $8.00 per running foot of dirt removed.
Below forty feet in depth, $10.00 per running foot of dirt removed.

Tunnelling

(*a*) In unfrozen ground, for first (25) twenty-five feet, $2.00 per running foot. Beyond (25) twenty-five feet, $3.00 per running foot.

(*b*) In frozen ground, for first (25) twenty-five feet, $3.00 per running foot. Beyond (25) twenty-five feet, $4.00 per running foot.

Drifting from Shaft

(*a*) In unfrozen ground, $2.00 per running foot.

(*b*) In frozen ground, $3.00 per running foot.

There shall be allowed, in addition, one dollar per running foot for every ten feet in depth of the shaft from which the drift is run. In measuring of the drift each running foot shall have a width of four feet, and where the drift is of a greater width, allowance shall be made for such additional work on a basis of each running foot having a width of four feet.

Timbering

In shaft, $3.00 per running foot.
In drift or tunnel, $2.00 per running foot.

Open Cutting

(*a*) Ground sluicing, 50c. per cubic yard of dirt removed.

(*b*) Stripping (by scraper), 75c. per cubic yard of dirt removed.

(*c*) Hand shovelling, $1.75 per cubic yard of dirt removed.

Drilling

In all cases, including both steam and hand-drilling, the actual cost of such work.

Hydraulicking, Dredging and Steam-Shovelling

Fifty cents per cubic yard.

Wood

The cutting and hauling of wood outside the limits of a placer claim shall not be allowed as representation work, as the cost of such is already provided for in the various classifications of work set out above.

Unprovided Cases

Other minerlike work for which special provision is not made shall be allowed at the actual cost, but for ordinary labour $7.50 per day per man employed shall be allowed.

All mining operations for the purpose of representing claims shall be done in a minerlike manner.

A wind-swept waste

(2) *Mineral Claims.*—The recorded owner of a mineral claim is entitled to hold it from year to year provided he shall do or cause to be done work on the claim itself to the value of $100.00 in accordance with the following schedule:

Ordinary sinking through dirt, gravel and muck, first ten feet $3.00 per foot; second ten feet $5.00 per foot; third ten feet $8.00 per foot.

Tunnelling or drifting through loose rock $10.00 per foot; for a shaft of 4′ by 6′ or a tunnel of the same dimensions.

Tunnelling or drifting through conglomerate $15.00 per foot for a shaft of 4′ by 6′ or a tunnel of the same dimensions.

Tunnelling or drifting through solid rock $25.00 per foot; for a shaft or tunnel of the above mentioned dimensions.

Cutting wood for use on a Quartz Mineral Claim, $4.00 per cord.

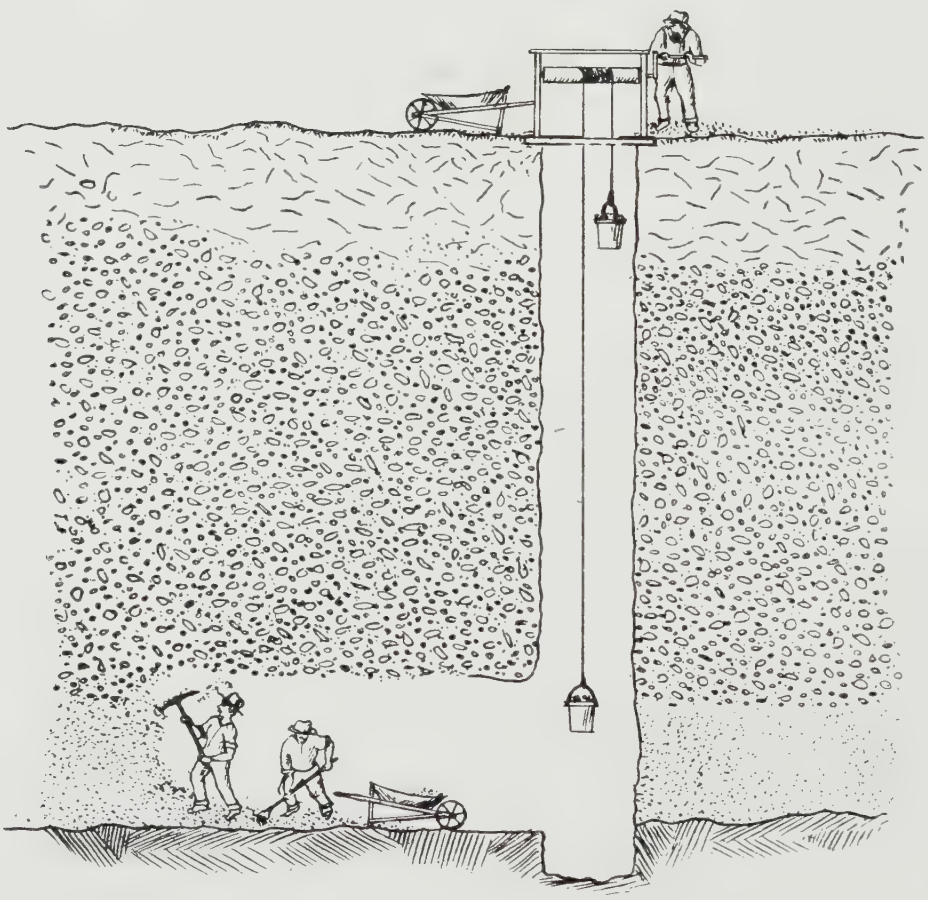
Cost of construction of a cabin on a Mineral Claim, $75.00.

and shall obtain a certificate of work. Payment, however, may be made to the mining recorder of the sum of $100.00 in lieu of representation work for each year.

PRIMITIVE PLACER MINING METHODS

Removing Pay Streak in frozen ground

by Windless and Bucket



GROUPING.—(1) *Placer Claims.*—The mining recorder may grant permission for a term not exceeding five years to the owner or owners of adjoining claims, which claims do not exceed ten in number to perform on any one or more of such claims all the work required to entitle such owner or owners to a renewal grant for each claim. The mining act provides, however, that where such claims are recorded in the name of more than one owner a partnership agreement creating a joint and several liability on the part of all the owners of the claims for the joint working of the same must be executed by each of the owners and filed with the mining recorder before permission is granted. Permission may also be given to group more than ten placer mining claims, some of which do not adjoin provided the gold commissioner is satisfied that such claims are to be operated by a system of mining which has a direct bearing upon all the claims affected and renders a considerable area necessary to successful operation by the system proposed, and that such application receives the approval of the commissioner.

(2) *Mineral Claims.*—Adjacent claims, not exceeding eight in number, may be worked by the owners in partnership provided a partnership certificate is obtained from the mining recorder, and the work, which may be performed on any one or more of such claims, will entitle the owners to a certificate of work.

ROYALTY.—(*a*) *Placer Claims.*—The royalty on all gold shipped from the Yukon is 2½ per cent, or 37½ cents per ounce, and the valuation of gold for royalty purposes is $15 per ounce.

(*b*) *Mineral Claims.*—No royalty or export tax shall be charged on gold extracted from a mineral claim in the Yukon Territory for a period of ten years from the 16th day of May, 1911.

(*c*) *Copper Location.*—No royalty shall be charged on the products of copper mining locations for a period of ten (10) years, that is up to the 1st day of January, 1921, and no reservation shall be made in the patents issued for such locations of a royalty on the sale of the products thereof during that period.

(*d*) *Iron.*—No royalty shall be charged on the products of locations granted under the provisions of these or any previous regulations for the mining of iron for a period of twenty years, from the 1st day of January, 1908, and no reservation shall be made in the patents issued for such locations of a royalty on the sales of the products thereof during that period, that is, up to the 1st day of January, 1928.

TITLE.—(1) *Placer Claims.*—Any person having duly located a claim may obtain a grant for one or five years by paying the fees prescribed and by performing the necessary representation work.

(2) *Mineral Claims.*—Any legal holder of a mineral claim acquired prior to the 12th of June, 1914, shall be entitled to a crown grant.

(*a*) Upon payment to the Dominion Government of the sum of $500.00 in addition to the price of the mining location at the rate of $1.00 per acre.

(*b*) By an expenditure of $500.00 in development work, the cost of the survey of the mineral claim not exceeding $100.00 to be counted as work done on

the claim provided it has been accepted in lieu of representation work for the year in which the survey was made.

Surface Rights.—Large stretches of the river beds in the Yukon have been acquired under the regulations governing the issue of leases to dredge for minerals, but with one or two exceptions, the dredges in the territory at the present time, are operating on creek claims or flats adjoining river beds. All claims that have been staked or otherwise acquired for the purpose of dredging are held subject to the provisions of the Placer Mining Act. The surface rights of a placer claim are not granted to any person other than the owner of the claim until the owner is given an opportunity to acquire such rights. This provision protects the dredge operator against litigation, which otherwise might be created by some

SELF DUMPER OPERATED BY STEAM

other person acquiring the surface rights of mining property, the surface of which must necessarily be destroyed by dredging operations.

Frozen Ground.—Throughout almost all the mining districts in the territory, with the exception of Kluane, the gravels are covered by a body of black frozen muck, which varies from 4 to 20 feet in thickness. The muck can be picked, but no impression can be made on the frozen gravels, which have to be thawed. 'The thickness of the frozen stratum varies considerably, and is less on the ridges than in the valleys, and on southern than on northern slopes. A shaft sunk on the ridge south of Eldorado creek reached unfrozen ground at a depth of 60 feet, while one in the valley of Eldorado creek, was stopped by running water at a depth of a little over 200 feet. Another shaft sunk through gravel, on the plateau between Bonanza creek and the Klondike river, passed through the frost line at a depth of 175 feet.' Near the head of Quartz creek a shaft tapped running

water at a depth of about 216 feet. 'The summer heat has little effect on the frozen layer except in the few places where the surface is unprotected by moss. Exposed gravel beds in favourable positions thaw out to a depth of from six to ten feet, but where moss is present, frost is always encountered close to the surface.' The depth of gravel varies from three feet on some of the creeks to 30 and 40 feet on lower Dominion and from 80 to 100 feet on Quartz creek. The frozen muck which overlies the gravels forms an exceedingly firm roof and no timbering is required in the drifts. The shafts in which self-dumpers are operating, however, are usually timbered as well as the tunnels leading from the bottom of the shafts to the face of the drifts. Underneath the frozen muck large chambers can be excavated during the winter. 'In one case on Dominion creek a muck roof unsupported by pillars covered a vault said to measure 140 feet by 230 feet and remained unbroken until midsummer. Examples of muck roofs spanning vaults over 100 feet in width are quite common.'

Bedrock.*—'The greater part of the gold both in the hill and creek gravels occurs on or near bedrock, either in the lower four to six feet of gravel or sunk for some distance in the bedrock itself. The distribution depends largely on the character of the bedrock. Soft schists such as those underlying the rich portion of upper Dominion creek prevent the gold from descending, and it accumulates in a thin layer at the base of the gravels. In many of the rich claims between the two discoveries on Dominion creek a thin stratum of gravel resting immediately on bedrock proved extraordinarily rich, while the bedrock and the upper gravels were comparatively lean. On Bonanza creek the bedrock as a rule is harder and more flaggy, and the action of frost has parted the layers and allowed a portion of the gold to descend along them. From three to five feet of bedrock are usually mined at a profit, and gold has been found in some quantity at a depth of twelve feet and probably descends still deeper. On a couple of claims on Hunker creek, below the mouth of Seventy Pup, practically all the gold occurred in a shattered porphyry bedrock, the overlying gravels proving almost barren. The bedrock underlying the hill of White Channel gravels is more decomposed than that in the creek bottoms, does not open out in the same way and retains most of the gold at or near the surface. In a few places gold has been found in paying quantities in the schist partings under the decomposed layer, but as a rule only the upper few inches are mined.'

Machinery.—Very crude devices were employed in the early days, *i.e.*, '98 and '99, to handle the pay dirt and recover the gold. The invention and introduction of modern mining machinery specially adapted to the frozen ground in the Yukon may be attributed to the experience and enterprise of resourceful miners and operators, the high price of labour, and the necessity of reducing the cost of operations in order to mine gravels carrying low grade pay. The self dumper, the steam points and equipment for thawing by hot water, have all been specially designed to meet the conditions that exist in the Klondike.

* R. G. McConnell, B.A., Geological Survey Report (No. 979).

Mining on Hunker creek

Grade of Gold.*—'Klondike gold varies greatly in grade, not only on different creeks but also along different portions of the same creek. The difference of grade is due to the gold being in all cases alloyed with silver in varying proportions**. In the lowest grade gold the silver almost equals the gold in volume, the ratio being 1 to 1.4. In high grade gold the ratio is 1 to 5 and the general average is 1 to 2.3. In value the ratio of silver to gold is very small, the proportion calculated from a number of returns being approximately 1 to 150**. While the grade of the placer gold is supposed to conform in a general way with that of the original vein gold, some changes are evidently produced by the leaching out of a portion of the silver contents. Evidence of loss of silver is afforded by the fact that fine gold which would necessarily be affected more by leaching than the accompanying coarse gold invariably carries a smaller percentage of silver. Nuggets also assay higher as a rule on the surface than in the centre. Five assays of selected nuggets made by Mr. Connor in the laboratory of the survey gave the following results:—

	Centre of Nugget	Surface	
1. Silver	35.8	29.4	Trail hill, Bonanza creek.
Gold	64.2	70.6	
2. Silver	39.9	33.5	Chechaco hill, Bonanza creek.
Gold	60.1	66.5	
3. Silver	37.3	30.3	Bonanza creek, No. 12 below.
Gold	62.7	69.7	
4. Silver	46.1	41.0	Treasure hill, Last Chance creek.
Gold	53.9	59.0	
5. Silver	33.0	33.5	Bonanza creek, No. 3 below.
Gold	67.0	66.5	

'All the nuggets with the exception of No. 5 show losses in silver of from five to seven per cent on the surface, assuming that the composition was originally uniform. No. 5 was a large nugget filled with quartz and its exceptional character is probably due to its being much younger than the others.'

Transportation of Gold.—The two main factors in the transportation of coarse gold by natural causes are grade and bedrock. With steep grades and smooth bedrock transportation is comparatively rapid, while little movement takes place when the grades are moderate and the valleys are floored with the tilted flaggy schists characteristic of the district. The Klondike slopes are everywhere mantled with a thick covering of broken and partially decomposed schist fragments easily moved when not frozen and ever tending downwards towards the creek and gulch levels. The downward movement is slow and intermittent at present on account of the perpetually frozen condition of the surface, except on sunny slopes. During the period of the White Channel gravels

* R. G. McConnell, B.A., Report of Gold Values in the Klondike High Level Gravels (No. 979).

—the period of the great gold accumulations—climatic conditions were less severe and the movement must have been much more rapid. The slide material carries with it the gold and gold-bearing quartz released by the breaking up of the auriferous quartz veins, and when running water is reached the gold is sluiced out and remains behind, while the rock fragments are ground up and carried away.

(*a*) *In gravels.*—The distance travelled by the gold after reaching the waterways, neglecting the time element, depends on the grades and bedrock. The upper portions of the creeks and the steep gulches, except where they cross the pay-streak of the White Channel gravels and are directly enriched from them, have not proved rich and are only occasionally productive. The gold washed down into them moves slowly on, and all the great accumulations occur on portions of the creeks with grades of 150 feet or less to the mile. Evidence of the tardy movement of coarse gold down streams of moderate grade, even where the latter are actively engaged in eroding their channels, is furnished at many points along Bonanza and Hunker creeks. The pay-streak of the elevated White Channel gravels has been destroyed in places along both these streams. Whenever this occurs the creek bottoms directly opposite the destroyed portions are immediately enriched, showing that the gold, or a large portion of it at least, has remained almost stationery during all the time the creeks were employed in deepening their channels from 150 to 300 feet. The complementary relationship existing between the creek and the hill pay gravels has been recognized by the miners, and whenever the creek gravels are lean, pay is confidently expected on the hills, and in the productive portions of the creeks is usually found.

(*b*) *On bedrock.*—The influence of bedrock in retarding or accelerating the progress of gold down stream is almost as important as that of grade. The common bedrock of the district is a light coloured flaggy sericite schist of unequal hardness and usually tilted at high angles. The sericite schist alternates in places with bands of dark graphitic schists and is broken through by numerous porphyritic dikes and stocks. The light coloured flaggy schists when had, form an excellent bedrock from the miner's point of view, as they weather unequally into irregular rock ripples, which arrest the progress of the gold. The partings also open out under the influence of the alternate freezings and thawings to which the rocks are subjected and the gold descends along them, and continues to descend as the surface is gradually lowered by erosion. Its progress down stream when caught in this manner is indefinitely delayed. The porphyritic rocks when shattered, as is often the case, also arrest most of the gold. The soft varieties of the sericite schists and the dark graphitic schists, on the other hand, offer small resistance to the passage of the gold. They weather to a smooth surface along which the gold moves easily, and the portions of the creeks underlaid by them are usually lean.

Purchase of Gold.—The banks in Dawson purchase gold either in the form of dust or dry amalgam. When the gold is presented at the banks, all foreign matter, such as sand, is blown out of the dust by the gold buyer, who

weighs it in the presence of the owner. The gold buyers have usually had considerable experience in handling gold, and by the appearance of the dust can invariably designate the creek from which it has been derived. The dust from the different claims is either purchased at a rate established by previous assays, or if the owner prefers, a receipt for the weight is given and a special assay is made. In making the assay the dust or amalgam is melted by the assayer, and the base metals (iron and copper) fluxed off. It is then poured into moulds and cleaned of any slag adhering to the gold. The bar is next weighed, and the difference in weight represents the loss in melting. Afterwards, sample chips are taken from the bar (along diagonal lines on top and bottom), and each chip is assayed. The results of the assay of each chip must check within one-tenth of a point of fineness. From the results of the assay a certificate of fineness is given, 1,000 fine representing pure gold at $20.67 per ounce.

The following is a list of the assay values of dust from some of the principal creeks, namely:

VALUES OF GOLD DUST

Name of Creek	Assay Value of Dust
Anderson	$14.88—$15.04
Adams	12.71— 16.43
American	17.86
All Gold	17.77
Bear creek	13.31— 14.86
Black hills	15.50— 17.67
Bonanza	16.12— 16.97
Ballarat	17.61
Big Gold	17.65
Barker	18.39— 18.60
Canyon	17.07
Claffy Pup	15.50
Clear	17.11— 17.77
Chechacko	15.50— 16.22
Caribou	16.86— 17.36
Canadian	17.86— 18.25
Conglomerate	16.35
Davidson	17.36
Deadwood	16.37
Dublin gulch	19.08— 18.23
Duncan	16.37
Dominion	16.80— 18.08
Eldorado	13.08— 16.18
80 Pup, trib. Hunker	16.47
Eureka	13.99— 15.02
French gulch	13.04— 13.97
Fortymile	16.82— 16.95
Gold Bottom	16.18— 16.47
Gold Run	17.57— 17.77
Gold hill	15.87
Glacier	17.46— 17.57
Goring	15.25
Gay gulch	16.12
Gauvin gulch	13.72

VALUES OF GOLD DUST—*Continued*

Name of Creek	Assay Value of Dust
Highet	17.26— 17.46
Herbert	19.53
Henry gulch	13.43
Haggart	18.29— 18.50
Henderson	14.98— 15.09
Homestake	13.70
Hunker	15.50— 16.90
Independence	16.12— 16.41
Indian River	17.44
Irish	12.89— 15.33
Jackson gulch	17.19— 17.38
Last Chance	14.09— 16.49
Lightning	17.15
Ledge	16.74— 16.84
Log Cabin	17.57— 18.50
Lombard	17.77
Lovett	16.86— 17.28
Little Blanche	13.60
Montana	15.91
Miller	17.09— 17.71
Minto	17.09
Minto lake	17.26
Moose	17.67
Matson	16.02
Monte Cristo	16.33
Mariposa	18.60
Mint gulch	17.59
Paradise hill	16.57— 15.74
Quartz	15.13— 16.20
Oro Grande	16.02
Sixtymile	16.70
Steep	19.24— 19.49
Stewart river	17.30— 17.57
Skookum	14.67— 15.48
Sulphur	16.53— 16.97
Scroggie	18.60— 18.70
Tenmile	17.38
Thistle	17.52— 18.50
Victoria gulch	16.68— 16.95

MINER'S UNITS.—The following table shows the standard weights and measures in placer mining in the Klondike:—

TABLE OF MINER'S UNITS

*5½	pans make	1 cubic ft.
15	pans make	1 wheelbarrow
4	wheelbarrows make	1 bucket
10	wheelbarrows make	1 cubic yard
†1	pan of gravel weighs	20 lbs.
1	cubic yard of gravel weighs	3,000 lbs.

* These measures are not to be construed as absolutely accurate, but are used by miners in making substantial or working estimates.

† Estimated weight average gravels.

Mr. T. A. Rickard in his book "Through the Yukon and Alaska" gives the following alluvial measures as being in common use in Alaska:

1 pan holds	25 lbs. of gravel
6 pans make	1 cubic ft.
15 pans make	1 wheelbarrow
10 wheelbarrows make	1 cubic yard
135 pans make	1 cubic yard
4 wheelbarrows make	1 bucket

These do not agree exactly. A full pan will hold from 20 to 25 pounds, and it requires from 125 to 135 pans to make a cubic yard. A cubic yard is usually estimated to weigh 3,000 pounds or 1½ tons. If a pan holds 20 lbs. and 150 pans equal a yard, then a cubic yard weighs 3,000 pounds. A loaded wheelbarrow will hold 1/10th of a cubic yard; this is the ratio recognized at Fairbanks and at Nome.

Low Level Gravels.—'The low level creek gravels are the most important gravels in the district. These gravels floor the bottoms of all the valleys to a depth of from four to ten feet. They rest on bedrock usually consisting of decomposed and broken schists, and are overlaid by a sheet of black frozen muck ranging in thickness from two to thirty feet or more. They are local in origin and consist entirely of the schists and other rocks outcropping along the valleys. The schists pebbles are usually flat round-edged discs measuring one to two inches in thickness and two to six inches in length. They constitute the greater part of the deposit, but are associated with a varying proportion of rounded and sub-angular quartz pebbles and boulders, and, less frequently, with pebbles derived from the later eruptive rocks of the region. The pebbles are loosely stratified, are usually embedded in a matrix of coarse reddish sand and alternate in places with thin beds of sand and muck.'

(*a*) *Creek.*—'The creek gravels frequently inclose leaves, roots and other vegetable remains, and also the bones of various extinct and still existing northern animals, such as the mammoth, the buffalo, the bear, the musk-ox and the mountain sheep and goat.'

(*b*) Gulch.—'The gulch gravels occupy the upper portions of the main creek valleys and small tributary valleys. They differ from the creek gravels in being coarser and more angular. A considerable proportion of their material consists of almost unworn fragments of schist washed down from the adjacent slopes. They contain the same vegetable and animal remains as the creek gravels.'

(*c*) *River.*—'The only river gravels of the district proven, so far, to contain gold in paying quantities occur in the wide flats bordering the lower portions of the Klondike river below the mouth of Hunker valley. The river gravels consist of quartzite, slate, chert, granite and diabase pebbles largely derived from the western slopes of the Ogilvie range. They are harder and better rounded than the creek gravels, a necessary result of the greater distance travelled.'

Ground sluicing

Terrace Gravels.—'Rock terraces occur at various points cut into the steep slopes of the present valleys. They were produced during the deepening of the valleys, and are simply remnants of former valley bottoms. They are small, seldom exceeding a few yards in width and a few hundred yards in length, irregular in distribution, and occur at all elevations up to the bottoms of the old valleys. The terraces support beds of gravel, usually from six to fifteen feet in thickness, very similar to that in the creek bottoms, but showing somewhat more wear. The terrace gravels, like the creek gravels, are overlaid, as a rule, with muck, and at one point on Hunker creek were found buried beneath a hundred feet of this material.'

High Level Gravels.—'They consist, principally, of ancient creek deposits, overlaid near the mouths of some of the valleys by gravels laid down by the Klondike river, when it ran at a much higher level than at present, and occupied a somewhat wider valley. These gravels occur at various points along the Klondike river. In the Klondike district they are found covering the small plateaus in which the ridges separating Bonanza and Hunker creeks from the Klondike river terminate. They rest in both places, on high level creek gravels at an elevation of about 450 feet above the present valley bottoms. They have a thickness of from 150 to 175 feet, and consist principally of well-rolled pebbles, of quartzite, slate, chert, granite, diabase and conglomerate embedded in a matrix of gray sand, and derived, like those in the present stream, from the western part of the Ogilvie range.'

(*a*) *White Channel gravels.*—'The White Channel gravels differ somewhat from the ordinary type of stream deposit. They are very compact as a rule and in some of the hydraulic cuts stand up in almost vertical cliffs, even when the face is unfrozen. The white or light grey colouration, from which the deposit derives its name, is very conspicuous in most of the sections but is not universal, as red, yellow and dark grey beds frequently occur. The deposit is highly siliceous, the principal constituents consisting of rounded pebbles and rounded and sub-angular boulders of vein quartz. Flat schist pebbles and boulders, usually in a more or less advanced stage of decomposition, occur with the quartz, and also occasional pebbles derived from the various dikes and stocks outcropping along the valleys. No material foreign to the districts occurs in the deposit. The pebbles and boulders are usually small, seldom exceeding eighteen inches in diameter, and are embedded in a compact matrix consisting essentially of small sericite plates and fine angular quartz grains . . ' The uniformity of the deposit in composition and general character throughout sections a hundred feet or more in thickness is very striking. The bedding planes, as a rule, are inconspicuous, and there has been no sorting of the various constituents into separate beds. The deposits, unlike the creek and gulch gravels, appear to be destitute of vegetable and animal remains. The thickness of the White Channel gravels varies from a few feet to 150 feet, and the original width from a couple of hundred yards to over a mile.

(*b*) *Yellow Gravels.*—'The white compact gravel deposit described above is overlaid in places by loosely stratified gravels known as the yellow gravels.

Sluicing or "Shovelling-in" on Dominion creek

The latter are of a rusty colour, are more distinctly stratified than the white gravels and consist mainly of flat schist pebbles lying loosely in a coarse sandy matrix.'

12. White Channel.—'The White Channel bench or hill gravels are the oldest in the district, and, excepting the present creek gravels, the most important from an economic standpoint. They were originally creek gravels, deposited in a similar manner to those occupying the low levels at present, and their elevated position is due to an uplift which affected the whole region bordering the Yukon from the Stewart river northwest to the Alaskan boundary and for a considerable distance beyond. This uplift, and a small depression which preceded it, produced many notable changes in the topography of the country. It is probably, although not conclusively proved, that during the White Channel period the lower portion of the Klondike valley, the portion into which the principal gold-bearing creeks discharge, was occupied by a small local stream and that the Klondike itself flowed either into the Stewart or into Twelvemile river. The White Channel deposits are remarkable in this respect that even when completely destroyed their former portion is marked by a trail of gold. They are traceable in this manner from the present mouth of Hunker, Bear and Bonanza creeks far out into the present valley of the Klondike, showing that the old valley was small, smaller than that of Hunker creek and unlikely to have contained a large rapid river such as the Klondike. At the close of the White Channel period the district was depressed and it was during this depression that the Klondike is considered to have broken into its present valley. It brought down an immense quantity of material from its upper reaches, and rapidly built up a wide gravel bed fully 150 feet in depth. These gravels at the mouth of Hunker and Bonanza creeks rest on the White Channel deposits and at other points, where not destroyed, are distributed along the hillsides at the same level. The depression was followed by an uplift of approximately 700 feet, which gave new life to all the streams by increasing their grades, and they immediately commenced to deepen their channels. This process was continued not only through the old gravel deposits but down into the bedrock to a depth of from 150 to 300 feet. The new valleys are sunk as a rule, through the bottom of the old ones, but in a few places, as at the mouth of Bonanza creek, they deviate from them and have carved out independent courses. The difference in character between the old and new valleys is striking. The old ones represent the product of long continued stable conditions, and are characterized by wide flats and gently sloping sides, from which all traces of angularity have been smoothed away. The flats of the old Hunker creek valley have a width in places of over a mile. The new valleys, on the other hand, while opening out into occasional basins, are generally narrow, steep-sided and angular. This applies only to the creeks, all of which are small, as the Klondike river has cut a huge trench through the district since the uplift. Only a portion of the deposits of the old valleys was destroyed during the excavation of the recent valleys, as the latter are much narrower and do not follow exactly the same course. The undestroyed portions constitute the White Channel gravels of the miners.'

CHAPTER IV.

PLACER MINING

PLACER mining in the Yukon commenced on the Lewes and Big Salmon rivers in 1881. Coarse gold was discovered on the Fortymile in 1886, and as a result the Stewart river was almost deserted the following year. The famous discovery on Bonanza creek, however, was made in 1896, and shortly afterwards ensued the great rush to the Klondike.

The following Table shows the value of the gold production in the Yukon since 1885, namely:

1885—1886	$ 100,000.00
1887	70,000.00
1888	40,000.00
1889	175,000.00
1890	175,000.00
1891	40,000.00
1892	87,500.00
1893	176,000.00
1894	125,000.00
1895	250,000.00
1896	300,000.00
1897	2,500,000.00
1898	10,000,000.00
1899	16,000,000.00
1900	22,275,000.00
1901	17,368,000.00
1902	11,962,690.00
1903	10,625,422.00
1904	9,413,074.00
1905	7,162,438.00
1906	5,258,874.00
1907	2,896,173.00
1908	3,200,288.00
1909	3,260,263.75
1910	3,594,884.05
1911	4,125,570.60
1912	4,024,245.80
1913	5,018,411.85
1914	5,301,497.26
1915	4,649,634.40
	$150,174,966.71

The following Tables show the extent of placer mining operations in the various mining districts during the year 1914:

DAWSON MINING DISTRICT

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
YUKON RIVER—										
(River Claims)			13					15		
(Bar Claims)								3		
Tulare			1							
Pelly										
MacMillan										
Cassie			1		5—15					
Selwyn								1		
Britannia	1	16	13	2— 4	12—15					
Canadian	2	20	5	0— 2	12—15					
Olga	1									
Kirkman	78			6— 8	10—12					
Summerfield	14									
Laderoute	4									
Hazel	1									
Thistle		1	22	2— 4	8—10					
Blueberry	6			2— 4	8—10					
Edas			3	2— 4	8—10					
Donohue	2									
Nesling (Trib. of Donjek)										
Nansen		18	12							
Cabin	2									
Discovery Pup		9	13							
Dolly			1							
East Fork of Nansen		3	7							
South Fork East Nansen		2								
Hyde	2									
Rusk	1	1	3							
Victoria										
Back		15	1							
Dome	1									
Webber		2	9							
WHITE RIVER—										
Caledonia	23									
Greenwood	12									
Flint	6									
Pauline	2									
Buck	4									
Mary	2									
Goodfellow	25			8—10	25—30					
Hill	2									
O'Brien	50		2	20—25	100—115					
Ellis	31									
Tumwater	3									

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
WHITE RIVER (Continued)										
Dean	4									
Gates	2									
Snag	2									
Beaver										
Pond	5					1				
Ella	6			nil	10—12					
Herbert	2			"	10—12					
Mutton	2			"	10—12					
Pan	9			2	12					
Plum	2			2	12					
Sarah	4			nil	10—12					
Bowen	30			2— 4	15—20					
Pilot	1			nil	10—12					
Kiltie	1			"	10—12					
Arden	4			"	10—12					
Hidden	10			"	10—12					
Cash	5			"	10—12					
Dempster	2			"	10—12					
San Pete				"	10—20					
Dolly	2			"	10—20					
Snare	2			"	10—20					
STEWART RIVER—										
Partridge	2									
Clear		5	105	0— 6	2—14			6		
Left Fork Clear creek	27	6	50	0— 6	2—14					
Barlow		2	11	4— 6	12—16					
Eldorado			9	4— 6	12—16					
Squaw			10	4— 6	12—16					
Black Hills		10	97	4— 8	6—14					
Right Fork Black hills	4			4— 8	6—14					
Childs	2			4— 8	6—14					
Sprague	1			4— 8	6—14					
Maisie Mae	2			4— 8	6—12					
Scroggie		8	31	2— 6	4—10					
Mariposa	2	9	26	4— 6	6—10					
Walhalla		1	2	2— 6	10					
Sharpe		1		2— 6	10					
Barker		9	36	4—10	8—15					
Dent's gulch			1	4—10	8—15					
Hine's gulch			1	4—10	8—15					
Henderson	72	6	12	5— 9	9—15					
L. Fork Henderson	6			5— 9	9— 5					
Emmeline	1		5	5— 9	9— 5					
YUKON RIVER—										
White river (Continued)										
Henderson										
Sixty gulch	2	5	6	10—25	5—10					
Eleven Pup	1			6—12	5—10					
Sixtymile river (River Claims)	98		3	4— 6	12—15	1				
Matson		6	20	10—14	8—10					

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
YUKON RIVER (Continued)										
Ten Mile	15	28	33	8—12	10—15					
August	1		1	8—12	10—15					
Pelland	2			8—12	10—15					
Scholtz	1			8—12	10—15					
Daniel	1			8—12	10—15					
Kasovia	1			8—12	10—15					
Indian river and creek		6	109	12	20			30		
(River Claims)			35							
Dominion			428				2	327		
Lombard			10	4— 6	8—12					
Trib. at No. 8 RL Lombard			1	"	"					
Little Dominion			2	"	"					
Trib. at No. 3 RL Lower Dominion			1	"	"					
Remington			1	4— 6	8—12					
Trib. at No. 15 below Upper Discovery Dominion			1	"	"					
Trib. at No. 21 and 22 below Upper Discovery Dominion			3	"	"					
Caribou			29	4— 6	10—15					
Trib. at No. 3 above Lower Discovery Dominion			2	"	"					
Trib. at No. 8 above Lower Discovery Dominion			1	"	"					
Trib. at No. 18 below Lower Discovery Dominion, L.L.			3	"	"					
Champion gulch			1	8—10	10—15					
Robinson			1							
Trib. at No. 36 below Lower Discovery Dominion			3							
Nevada			1	10—15	20—30			1		
Hunter			2	"	"					
Laura			1	"	"					
Jensen			5	"	"					
Burnham			1	"	"					
Eagle			1	"	"					
Bullfrog			1	"	"					
Vic Grant			1	"	"					
Rob Roy			1	"	"					
Veronica			1	"	"					
Skinner	1			"	"					
Gold Run			91	4—10	10—45			22		
Trib. at No. 254 below Lower Discovery Dominion			1	15	60					
Sulphur		6	221	12—20	6—20			7		
Brimston			1	"	"					

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
YUKON RIVER (Continued)										
Indian river (Continued)										
Dominion (Continued)										
Green gulch			3	12—20	6—20					
L. Fork Green gulch		1								
Friday gulch	1	2		6— 8	10—20					
Scribner			2	4— 8	4— 6					
Australia	2		2	6—10	10—20					
Wounded Moose	2			"	"					
Eureka	1	6	53	4— 6	10—15					
L. Fork Eureka	2		7	"	"					
Trib. at No. 18 E. Fork			2							
Montreal			1							
Quartz		1	92	6—10	8—12		5	46	6—15	12—80
Canon			9				1	4		
Little Blanche		1	11				1	2		
L. Fork Little Blanche		1								
Trib. at No. 30 Little Blanche	1	1								
Claffey's Pup			3	6—10	8—12					
Trib. at No. 19 and 20 below A. Mack's			2							
Calder	1									
Ophir	1									
Dion Gulch			8					2		
Falconer			8					8		
Snawise			1							
Moosehide			1							
Clear			1					1		
Bluevale			1							
McCluskey			1					2		
Reliable			1							
Reliance			1					3		
Hale			2							
Fortymile river								2		
Moose		2	1							
Herbert		1	1							
Log Cabin		2								
Little Dome			1							
Cub	1									
Majau	1									
Klondike river (River Claims)			9	10	30			44		
Flat		5	14	2— 6	8—15					
All Gold	24	3	8							
Fraser	1									
Finnie	1									
Alexander	1		1					2		
Trib. at No. 71 below Discovery	1									
Marsh	20									
Jean	1									
Connors	1									
Goring			1	2—10	6—60					

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
YUKON RIVER (Continued)										
Klondike river (Continued)										
Rabbit			2							
Hunker		7	225	12—16	6—10		9	182		
May gulch			5							
Mint gulch			5	0— 4	10—15					
Trib. at No. 2 and 3 below Discovery			2							
Roger's gulch			2							
Little Jem			4	2— 4	4—10					
Trib. at No. 23 A. below Discovery			1							
Gold Bottom		2	67	0— 5	8—12			20	nil	8—25
Independence			3	10—16	8—12			1		
Hubrick gulch			1					2		
Mitchell gulch			1					1		
Hester creek			12	4—10	8—10			10		
Trib. at No. 10 L. Limit Hester			2							
Johanna			1							
Trib. at No. 77 below Discovery RL. Hunker			1							
Eighty Pup			16					12		
Dutton Pup			4					1		
Preido gulch			1							
Last Chance			35	6—12	6—12		2	63	0—	8—25
Trib. at No. 15 above Discovery Last Chance			15	12—25	4— 8			1		
Trib. at No. 8 above Discovery Last Chance			4	15—20	4— 8			1		
Discovery Pup Last Chance			4					2		
Pup at No. 8 above mouth			5	15—30	4— 8			1		
Henry gulch		1	5							
Benjamin gulch		2	2							
Bordeleau gulch	1	1	7							
Dago gulch			2							
Hattie gulch			11					1		
Bear			57	0— 5	10—20					
Trib. at Discovery RL. Bear			1							
Jackson gulch								10		
Crofton			1					1		
Bonanza		7	337	6–12	8—14		5	137	10–100	
Victoria gulch			21	0— 4	10—15	1				
Trib. at No. 7 Victoria			9	0	4—10					
Trib. at No. 11 R.L. Victoria			1							
McKay gulch			2							
O'Neil gulch	2	5	10	0— 5	10—15	1				

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
YUKON RIVER (Continued)										
Klondike river (Continued)										
Homestake	1	1	15							
Nigger Jim						3				
Gauvin			13	4— 6	10—18					
Trib. at No. 19 above Discovery Bonanza	3		1							
Eldorado		4	98	6—12	8—14	1	3	37		
Chief gulch	1	1	13	2— 6	8—15					
Nadeau	1									
Gay gulch		1	15	0— 5	10—16					
Ora Grande			5	0— 5	4—10					
Nugget gulch		1				6				
Trib. at No. 27 R.L. Eldorado			2							
Little Eldorado	1									
French gulch	5	1	5			1		4		
Trib. at No. 13 Eldorado			3							
Irish gulch		5	5							
Big Skookum			10	4— 6	8—14			2		
Little Skookum			4	"	"					
Adams			21	"	"			6		
Stampede			2							
Magnet			6	0— 5	8—16			2		
American			8	"	"			1		
Fox			4	"				3		
Monte Cristo			2	"				2		
Boulder			7	"						
Fortynine gulch			6					2		
Cripple								3		
Trail gulch			6					2		
Trib. at 81 A. below Discovery L.L. Bonanza			1							
Lovett gulch			11	0— 5	8—16			60	nil	10–200
Trib. at No. 2 above Discovery Lovett			3					2		
Examiner gulch			13	0— 5	6—12			4		

SUMMARY OF GRANTS ISSUED DURING 1914

Locations:—			
Creek claims	604		
Hill claims	15		
River claims	98		
Total locations		717	
Relocations:—			
Creek claims	259		
Hill claims	28		
Total relocations		287	
Total original grants			994
Renewals:—			
Creek claims	2,876		
Hill claims	1,104		
River claims	60		
Bar claims	3		
Total renewal grants			4,043
Total grants issued			5,037

Quantity of wood used in these operations ..... 45,000 cords.

SIXTYMILE MINING DISTRICT

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
Sixtymile above Miller	62	....	....	4—15	6—15	16	....	....	10—40	6—20
Below Miller	5	3	25	4—12	6—12	8	6	15	6—12	5—20
Below Big Gold	5	1	27	6—12	6—10	14	6	7	6—12	5—10
Below Fivemile	16	2	28	6—18	6—10	19	....	3	6—20	5—20
Below Twelvemile	58	3	13	6—30	6—12	3	....	....	6—30	5—10
Below California	8	....	....	6—20	6—12	....	....	....	6—30	5—20

Quantity of wood used in placer mining operations ..... 5,000 cords.

SIXTYMILE MINING DISTRICT

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
Glacier	....	3	57	3—20	6—30	....	....	3	3—20	6—30
Biggold	3	2	28	3—30	6—20	10	....	4	3—15	7—30
Miller	....	2	10	3—25	6—40	....	....	....	.....	.....
Bedrock	1	14	8	3—10	2—12	....	....	....	.....	.....
Little Gold	10	2	2	3—15	4—20	....	....	....	.....	.....
Weatherly gulch	....	....	1	20—30	6—12	....	....	....	.....	.....
Guay gulch	1	.....	.....	10—30	6—13	....	....	....	.....	.....
Boucher	10	.....	.....	10—20	4—20	....	....	....	.....	.....
California	3	.....	.....	5—20	6—10	....	....	....	.....	.....
Fivemile	1	....	1	3— 8	5—15	1	....	....	20—40	6—16

DUNCAN MINING DISTRICT

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
Highet	72	....	72	4— 8	16—30	....	....	....	.....	.....
Rudolph	1	....	1	4— 8	6—10	....	....	....	.....	.....
Forty Pup	1	....	1	4— 6	50	....	....	....	.....	.....
Minto	21	....	21	4—10	.....	....	....	....	.....	.....
Astoria gulch	1	....	1	.....	18—30	....	....	....	.....	.....
Sunrise gulch	1	....	1	.....	16—25	....	....	....	.....	.....
Sunset gulch	1	....	1	.....	16—25	....	....	....	.....	.....
McIntyre	3	....	3	4— 6	8—16	....	....	....	.....	.....
Jarvis	1	....	1	"	"	....	....	....	.....	.....
Duncan above Bridge	20	....	20	4—10	8—14	....	....	....	.....	.....
Duncan below Bridge	2	....	2	2— 4	6—20	....	....	....	.....	.....
Duncan below Discovery	6	....	6	2— 6	100	....	....	....	.....	.....
Duncan above Discovery	11	....	11	.....	.....	....	....	....	.....	.....
Duncan	1	....	1	.....	.....	Disc. Bench	....	1	14—10	60
Duncan	2	....	2	4—10	60	....	....	"	"	"
Secret	11	....	11	4— 6	.....	....	....	....	.....	.....
Johnson	3	....	3	.....	.....	....	....	....	.....	.....
Carlson	11	....	11	4— 6	24—26	....	....	....	.....	.....
McLagan	2	....	2	6	18—20	....	....	....	.....	.....
Thunder gulch	2	....	2	2— 4	10—12	....	....	....	.....	.....
Lightning	3	....	3	.....	.....	....	....	....	.....	.....
Gull	1	....	1	4— 6	16—18	....	....	....	.....	.....
Corkery	3	....	3	.....	.....	....	....	....	.....	.....
Haggart	30	....	30	4— 6	6—12	....	....	....	.....	.....
Dublin gulch	6	....	6	2— 6	12—30	....	....	....	.....	.....
Gill gulch	1	....	1	4— 6	14—16	....	....	....	.....	.....
Roden	1	....	1	6	20	....	....	....	.....	.....
Coronation	1	....	1	4— 6	.....	....	....	....	.....	.....
Sabbath	1	....	1	2— 6	20	....	....	....	.....	.....

KLUANE MINING DISTRICT

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
Duke	1				12—50					
No Horn	3				15—20					
Big Horn	34				5—15					
Burwash	4	9	15		20—30					
Cooper	1				0—60					
Cultus	2				0—70					
Ore Grande Channel	4				12—20					
Britannia	4			10—40						
Elevated Pup, L.L. Burwash	1				14—20					
Florrie	2				0—75					
Verona	5				0—15					
Fourth of July		2	10		5—50					
Snyder			1		5—10					
Ruby			5		5—70					
Arch		4	2		5—20					
Gladstone			10		5—15					
Sheep			1		0—30					
Bullion		1			12—15					
Tatamagouche		1			12—14					
	61	17	44							

WHITEHORSE MINING DISTRICT—Big Salmon Mining Division

Name of creek	Creek claims					Hill and bench claims				
	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet	Location	Relocation	Renewals	Depth, muck, in feet	Depth, gravel, in feet
Little Violet			1		10—20					
Cottoneva		3	5	10—15	10—20					
Livingstone		1	28	5—150				2	15—20	10—60
Summit			6	3—12	8—50					
Dry gulch			1	0—10	0—35					
Brown			2		5—20					
Lake			1		5—20					

MINING METHODS AND COSTS

1. Prospecting.—The first work the prospector does on a new creek is to pan wherever the bedrock is exposed by the action of water. (Bonanza creek was accidentally discovered by Carmack, who panned in this way, and staked without further prospecting.) If, after panning, favourable prospects are found, a small space of ground is cleared and a shaft, usually 3 feet by 5 feet, is sunk to bedrock. It is not necessary to thaw the frozen muck, which can be broken with a pick, but when the gravel is reached it is necessary to make a fire on the bottom of the shaft and thaw downwards until bedrock is reached. Another method of thawing the gravel is by boulders which have been heated in a fire. The warm boulders are dropped on the bottom of the shaft and covered with moss or brush. Either process thaws from one to two feet of gravel in about five or six hours. (Thawing with boulders is described under paragraph 4.) Dirt can be thrown out of the shaft to a depth of about ten feet, and then it is necessary to use a windless to hoist. The gravel removed from the shaft is also panned at frequent intervals. The general rule is that if there is pay at all in the gravels, it is richest on or in bedrock. Paradise Hill, on Hunker creek, however, has furnished an exception to this rule. 'The main gold zone here in many places is found not in bedrock, but at elevations of from three to twelve feet or more above it.' To drift or tunnel, a fire is built against the side of the shaft, and the necessary amount of gravel is excavated. To prospect on creeks where a small boiler can be used, the procedure is somewhat different. A small Porcupine boiler of 3 h.p., which furnishes steam to three points is generally utilized. A half inch pipe can be driven through 10 feet of muck in about five hours. To sink a shaft of 20 feet in this way requires about one cord of wood for thawing, and two men will remove the dirt from the shaft in two days.

2. Thawing.—'The gold-bearing gravels in the Klondike are perpetually frozen and have to be thawed by one of the various methods employed in the district. Even if mechanical appliances were devised to excavate these gravels in a frozen condition, a process of thawing would be necessary before the gold could be recovered. The efficiency of any one method of thawing varies with the quantity of humidity in and the compactness of the gravels. Nearly all the gold-bearing streams of Post Tertiary age are frozen to bedrock and artificial thawing is absolutely necessary, while those of most recent age are only partially frozen and do not require artificial thawing.'

CLASSIFICATION OF THE METHODS OF THAWING

Natural thawing	1.	The sun.
Artificial thawing	1.	Rocks.
"	2.	Wood.
"	3.	Steam points.
"	4.	Hot water.

3. Natural Thawing.—'The method of exposing the gravels to the sun to thaw has not been universally adopted, partly because the overburden

cannot be removed on account of the lack of water and grade and partly on account of the short seasons. It has not yet been demonstrated whether it is possible, either from a physical or economic point of view, to thaw a creek gravel deposit of 15 feet in depth. The surface of all creek bed deposits is covered with moss overlying a layer of frozen soil—known as "muck"—from a few feet to 14 feet in thickness. Before the rays of the sun can effectually penetrate the muck, the moss has to be removed by artificial means. If the grade is available the muck is removed by ground-sluicing. Where the body of gravel is exposed the sun will thaw from four to five feet in one season, but where this depth is exceeded, it is necessary to thaw by artificial means where dredges are operating. In open-cut work, where the material is excavated with the pick and shovel, the sun's rays are sufficient to thaw for a number of shovellers according to the area of gravels exposed. In all hydraulic operations the heat of the sun is the only medium of thawing. The monitor is placed in such a position that it can be directed alternately on certain areas, the face of the gravels usually being worked in three sections, *i.e.*, while the water is directed on one section the other two sections are thawing. In this way the sun will supply sufficient material to keep the monitor operating.'

4. Thawing with Rocks.—'The method of thawing with rocks is not now practised. During the period of early mining in the Fortymile district. rocks were heated in a fire on the surface of the ground, and then dropped on the bottom of the shaft, where they were covered with tin or sheet iron to concentrate the heat. Rocks were also used to thaw the ground for drifting. Thawing with rocks concentrates the heat, and obviates the sloughing of the side of a shaft. In many localities the muck contains streaks of sand through which the heat is more rapidly conducted, and as a result a portion of the roof may fall down or "cave-in," as it is usually termed.'

5. Thawing with Wood.—'The several species of wood available for thawing purposes are, spruce, cotton-wood and jack pine, the latter kind being scarce the former species are chiefly used.'

6. Thawing Bar Diggings.—'The method employed in thawing bar diggings in the Fortymile district was as follows, namely:—

An area of about 50 feet square was stripped of ice, and a portion of this area, 20 feet in length by 6 feet in width was thawed by one fire, this being the quantity one man could excavate before the thawed ground was again affected by the frost. A row of kindling, two feet in width was placed along the whole length of the twenty feet, and covered with dry spruce. A second and third row of wood was placed on top and sheet iron or tin was used as a complete cover, so that the wood could smoulder and the heat be retained or concentrated within the area to be thawed. The quantity of wood necessary to thaw an area of ground 20 feet long by 6 feet wide and 1½ feet deep, was estimated at 1½ cords.'

7. Wood Thawing in Drifts.—'The method of thawing with wood in drifting operations is practically the same as that employed in bar diggings,

but more care is exercised in placing the fires. This method is employed only in small drifting operations, when the material is hoisted with a windlass. To expedite the work in the drifts it is customary to sink two shafts from 50 to 75 feet apart. While the drift from one shaft is being thawed, the dirt from the other shaft is hoisted from the other shaft. The mode of placing the wood along the face of the drift is as follows: Kindlings about one foot in width are placed along the face of the drift, and then a layer of wood. Dry spruce is placed on top of the kindlings for a width of a foot on each side. On top of the dry spruce

Dominion creek. Gravels exposed after muck was hydraulicked. North-West Corporation, Limited

is placed a layer of green spruce, which in turn is covered by sheet iron. The spruce and sheet iron keeps the fire smouldering and concentrate the heat. When bedrock is thawed the same method is applied, but the wood is placed lengthwise along the drift, the end of one stick resting on the end of the other. Fires of this kind burn for three or five hours.'

8. Thawing with Hot Water.—'This method is employed to the best advantage when the gravels are compact and contain very little sediment. Where the gravels are thawed by this method a much greater quantity of dirt can be handled by the shovellers than when the ground is thawed by either wood or steam. The method may be described as follows: A sump-hole is made at the bottom of the shaft, about five or six feet below the level of the drift, and a pulsometer or a duplex Worthington pump is installed on top of the sump-hole.

The steam from the boilers is conducted through an iron pipe, down the shaft, to the pump or pulsometer, as the case may be. At the bottom of the shaft there is a small pressure pump, to which is attached a fire hose with nozzle. The water from the sump-hole is pumped on the face of the drift, and returns to the sump-hole by means of a small ditch dug along the side of the drift. The same water is used several times, and when it accumulates, as a result of the humidity of the gravels, it is pumped out of the shaft. The water is kept warm either by the fresh steam from the boilers or the exhaust from the pump or both. The duty of a No. 7 pulsometer is about 60 cubic yards in ten hours.'

9. Thawing with Steam Points.—'Steam thawing is employed in three distinct kinds of operations, drifting, open-cutting and dredging.'

The Point.—'A "point" is made of extra hydraulic pipe, is 6 feet in length and has a bore of 1½ inches to ⅜ of an inch in diameter. They have solid standard heads, which stand the blow of a six or eight pound hammer.'

Connections.—'The points are connected with batteries of four each, having a separate steam hose—usually ½-inch—and steam valve, and each battery is connected with the main steam line ¾-inch steam hose and valve.'

Supply of steam.—'To do efficient work each point requires steam equal to 1½ h.p., boiler capacity, *i.e.*, a 30 h.p. boiler will furnish steam to 20 points. If a smaller boiler is used for this number of points, much trouble will be experienced in firing and supplying the boiler with water.'

Duty of a steam point.—'The quantity of ground that can be thawed with a steam point varies from 3 to 6 and often 7 cubic yards in 10 hours. The efficiency of the point varies according to the compactness of the gravels, the quantity of humidity in the gravels and the area to be thawed and as to whether it is in a drift or ahead of a dredge. In drifting operations the average duty of the point is 3.75 cubic yards in 10 hours."

Point setting.—'When points are set in the face of a drift they are first driven about two feet, and allowed to remain at this length for an hour or so. They are then driven other two feet, and finally driven the full length. The points are set about three feet apart in average gravels, but only about 2½ feet in compact gravels. Care has to be taken that only the pay material is thawed, otherwise waste material will have to be removed.'

10. Thawing Ahead of Dredge.—'All the dredges operating in frozen ground have steam plants for the purpose of thawing the gravels ahead of the dredge. The size of the plant depends on the number and capacity of the dredges in operation. The boilers used in operations of this kind are from 100 to 150 h.p. The steam is transmitted from the main station across the area to be thawed, by means of a main steam pipe from which there are many laterals conducting steam to batteries of 4, 6 and 8 points. All the main steam pipes are inclosed in a wooden box to avoid the condensation of the steam. The points are set from 4 to 6 feet apart and are from 12 to 15 feet in length, and are left in place for eight hours. The duty of a point under these conditions is from 5 to 7 cubic yards in ten hours.'

Panorama of Twelvemile valley from intake of pipe crossing Little Twelvemile valley, showing the Yukon Gold Company's power plant

11. Ground Sluicing.—'This method consists of concentrating the stream on the gravels, which are thus removed by water without pressure. To successfully operate by this method it is necessary (1) to have a plentiful supply of water, (2) to operate in shallow gravels, and (3) to have a stream of sufficient grade to move the material. When the whole material from surface to bedrock is removed in this manner the method is known as "ground-sluicing"; when only the over-burden is removed the method is known as "stripping." This work is easily done in the early spring by taking advantage of the spring floods and leading the water by several channels across the claim. The muck thaws easily and the streams soon cut down to the gravel, and then gradually widen their channels until they meet. In some cases the process is hastened by blasting out the walls of the muck channel with slow explosives. The upper portion, if barren, is removed and piled up where most convenient, and the underlying pay gravels are shovelled up or hoisted in buckets, and sluiced in the ordinary way.'

12. Sluicing.—An abundant supply of water is essential to successful placer mining. After a winter dump has been thawed by steam points the dirt is moved to the sluice-boxes in various ways. One method is to scrape the dirt into a dump box at the head of the line of sluice-boxes. This is usually done by a steam scraper. Another method is to pump the water to sufficient elevation, so as to give a pressure to hydraulic the dirt from the dump into the sluice-boxes. When the water is convenient, however, probably the most economical mode of sluicing a dump is to place two sluice-boxes parallel to each other, on the space of ground where the dirt is to be dumped. These boxes are covered by short wooden planks or some other sufficient covering to keep clear the space through which the water runs in the process of sluicing. In the spring the sluice-boxes are gradually uncovered from one end, and the work of shovelling in, *i.e.*, depositing the dirt in the sluice-boxes, can be accomplished by two or three men. This method obviates the necessity of employing a large number of shovellers. In order to confine the dirt within a limited area, cribbing is constructed around the dump so that the dirt is retained within easy access of the sluice-boxes. On many of the claims, however, the water for sluicing purposes, instead of being conveyed by flume from a point at a sufficient distance up the creek to give the required grade, is pumped up, and the sluice-boxes are placed high enough to carry the tailings where required, thus obviating the expense of handling or scraping tailings. During the summer the dirt or pay gravel is carried directly from the shaft and dumped into the sluice-boxes from the bucket attached to the self-dumper. By the open-cut method in shallow ground, however, the pay gravel is sometimes conveyed to the sluice-boxes by the ordinary wheelbarrow.

13. Self-Dumper.—The self-dumper or carrier was designed specially for the Yukon, and to meet the requirements of the miners for some light and simple machine that would hoist and convey the dirt from the bottom of the shaft or from an open-cut, to the dump or sluice-box. The carrier is operated on a single three-quarter inch cable stretched between two posts, and usually at an angle of about 40°, but if necessary at a much less grade. One post, about

five feet high, is situated in rear of the shaft, and the other post, which is called the 'gin-pole,' is erected at whatever point the dirt is to be dumped. The carrier itself is worked by a single $\frac{3}{8}$ inch or $\frac{1}{2}$ inch cable. The hoisting cable extends from the drum of the engine to the top of the gin-pole where it passes through a block and extends to the carrier, which, for example, is at the top of the shaft. The cable passes through a sheave in the carrier and extends down the shaft, passing through a block attached to the bale or handle of the bucket and then returning to the carrier, where it is fastened. When the signal to hoist

Muck bank, Dominion creek, showing the action of water by ground sluicing. North-West Corporation, Limited

is given the cable winds around the drum of the hoisting engine, quickly lifting the bucket from the bottom of the shaft to the carrier, where the handle of the block, which is attached to the bucket bale, lifts the hook in the centre of the carrier, thereby releasing the sliding latch and automatically locking the hook and holding the bucket securely in the centre of the carrier. This occupies only the fraction of a second, and the travel of the carrier is not impeded. The dumper is then pulled along the carrying cable to the point where the dirt is to be dumped. A chain is attached to the front side of the bucket, and at the end of the chain is a ring, which passes along a cable fastened at both ends and lying upon the ground directly under the carrying cable. When this ring comes in contact with a clamp, which is fastened to the cable, the bucket is prevented

from going any farther and the strain on the chain overturns the bucket and the contents are emptied on the dump. After dumping, the hoisting cable is slackened and the dumper or carrier rapidly travels down the cable until it reaches the top of the shaft. An eccentric hook attached to the sliding latch in the carrier strikes a ball fastened on the carrying cable This action releases the sliding latch, unlocks the hook, and disconnects the handle of the bucket from the carrier. The bucket then travels down the shaft to be re-filled.

Cost of complete pumping, thawing and self-dumping outfit suitable for working ten shovels (or 16 shovels if power is not required to pump).

TABLE I.

40 h.p. Scotch Marine Water Back Boiler, return flue	$1,300.00
15 h.p. Horizontal engine	375.00
6 h.p. Gould centrifugal pump (with foot valve attached)	300.00
10 h.p. hoisting engine	450.00
Self-dumping carrier and turnbuckle	100.00
200 ft. ¾″ cable	38.00
500 ft. ⅜″ cable	50.00
*20 ½″ thawing points, 8 ft. long	200.00
4 wheel-barrow bucket	60.00
10 Pan-American wheel-barrows	100.00
100 ft. ⅝″ steam hose	65.00
1 dozen Silver Dollar shovels	18.00
200 ft. ¾″ pipe	24.00
Miscellaneous tools and fittings	125.00
	$3,205.00

The self-dumping carrier can be used with a much smaller plant, and is in general use where only five or six shovellers are employed. In a smaller plant the cost of boiler, engine and hoist is much less than the figures quoted.

The following two tables, showing the cost of sinking shafts, were furnished by two different operators on the watershed of Indian river, namely:—

TABLE II.

SINKING BY SELF-DUMPER

(30 ft. deep, and 8 by 8 ft.)

1 boilerman†	$6.50	One shift.
1 pointman†	7.00	
1 hoistman†	7.00	One shift.
2 shovellers† at $6.50	13.00	
½ cord wood (fuel)	4.00	
3⅓ cords (timbering) at $8	26.66	
	$64.16	

7 ft. thawed and hoisted in 12 hours.

Cost of 7 ft. (including timbering)	$64.16
Cost per ft	9.16

* To thaw by hot water instead of steam the points would be substituted by a pump at an approximately similar cost

† These figures include an allowance of $2.00 per day per man for board, *i.e.*, 1 boilerman at $4.50 plus $2.00.

TABLE III.

In this case the shaft was 55 feet deep and 8 by 8 feet, and the dirt was hoisted by hand windlass.

Labour	$400.00
Timbering, 6 cords at $8	48.00
Dressing timber	50.00
Steam for thawing, at $1 an hour, 50 hours	50.00
Cost of 55 ft.	* $548.00
Cost per ft.	$9.96

TABLE IV.

Tunnelling by Self-dumper

(6 ft. by 6 ft.)

7 to 12 p.m.—1 pumpman	$ 7.00	Thaws 5 hours.
1 helper	6.00	
1 fireman	6.50	
1 to 6 a.m.—1 engineer	7.50	
6 shovellers at $6.50	39.00	
Wood consumed, ¾ cords	6.00	
Timbering 12 ft. of tunnel, ⅔ cords	5.33	
	†$77.33	
6 feet of dirt excavated on each side of shaft in 12 hours.		

Cost of 12 ft.	$77.33
Cost per ft.	6.44

The six shovellers take out the dirt and timber the portion of the tunnel that has been excavated. If the roof is muck, it is not necessary to timber. When the roof is gravel, the tunnel is timbered to obviate the sloughing of rocks and dirt, which would impede the progress of the work along the tunnel. It is claimed that the best method is to thaw five hours for the reason that the water becomes warm when thawing for ten hours, and as a result the roof is more liable to slough, the dirt piles up and blocks the operations of the nozzleman and the shovellers work at a disadvantage.

The following table, which was furnished by one of the most successful operators on the Indian river watershed, is taken from a 42 days' run, and shows the working cost per sq. ft. of bedrock, *i.e.*, the actual cost of thawing, hoisting and sluicing, the dirt being dumped from the bucket into the sluice-boxes:—

* The cost of sinking this shaft was furnished by one of the most successful operators on the watershed of Indian river, and is based on the prices of the present day, the shaft having been sunk in June, 1909.

† These figures include an allowance at the rate of $2.00 per day per man for board.

TABLE V.

Thawing Crew—	
2 pumpmen at $6.00	$ 12.00
2 helpers at $5.00	10.00
1 fireman at $5 00	5.00
3 cords wood at $8.00 per cord	24.00
Hoisting Crew—	
1 foreman at $6.00	6.00
1 engineer at $6.00	6.00
1 dumpman at $5.00	5.00
1 bucketman at $5.00	5.00
12 shovellers at $5.00	60.00
Wheeling planks at $75.00 per M	10.00
21 days' board* at $1.75	36.75
	†$179.75

The quantity of material handled per day of 10 hours was 590 sq. ft. of bedrock, the dirt hoisted being approximately three feet deep.

Cost of handling 590 sq. ft. of bedrock	$179.75
Cost per sq. ft. of bedrock	.30

The following table, which was furnished by a skilful operator, shows the working cost of a self-dumping plant, namely:—

TABLE VI.

Working Cost of Self-dumper

Thawing Crew—		
‡2 pumpmen at $7.00 per day		$ 14.00
‡1 helper at $6.00 per day		6.00
‡1 fireman at $6.50 per day		6.50
Hoisting Crew—		
‡1 foreman at $8.00 per day		8.00
‡1 engineer at $7.50 per day		7.50
‡1 dumpman at $6.50 per day		6.50
‡1 bucketman at $6.50 per day		6.50
‡16 shovellers at $6.50 per day		104.00
3 cords of wood at $8.00		24.00
Box candles		3.50
Coal, 25c.; oil, 25c		.50
Picks (Life one month) 16 at $2.50	Per day	2.13
Shovels (Life one month) 16 at $18.00 per doz		
Wheeling planks (Life three months) at $75.00 per M. per day		.25
		$ 189.38

The capacity of the above plant, equipped with two No. 6 pulsometers, would be approximately 600 sq. ft. of bedrock, the dirt hoisted being between 3 and 4 ft. deep.

600 sq. ft. of bedrock	$189.38
Cost per sq. ft. of bedrock	.31**

* In this case the board of 21 men is reckoned at $1.75 each.

† It will be noted that the wages paid by this operator is above the average, and it necessarily follows that only the best men are employed.

‡ These figures include an allowance of $2.00 per day per man for board.

** The above table includes the cost of thawing, hoisting and sluicing.

Hydraulic operations on American hill

Hoisting by Windlass.—The following information, which was furnished by a miner on Lower Dominion, will give an idea of the cost of hoisting the dirt by hand windlass: (On many claims on the lower portion of Dominion the pay gravel is thawed by fires of kindling wood, and described under paragraph 7 of this Part, and the dirt is hoisted by hand windlass.)

TABLE VII.

Plant

1, 5 h.p. boiler.
40 ft. ½-inch steam pipe.
2 steam points with hose.
1 lead hose, 10 ft. (to connect point battery with steam pipe).
1 windlass with 40 ft., ¾-inch rope or ¼-inch cable.
2 windlass buckets.
Picks and shovels.

TABLE VIII.

Working Costs

(Sinking shaft 3 by 5 ft.)

The ground is thawed for five hours in the afternoon and allowed to cool over night. The thawed dirt is then hoisted in five hours next morning. Two men thaw and take out six feet of dirt in one shift, *i.e.*, ten hours. Approximately one cord of wood is sufficient fuel to thaw a shaft 30 feet deep.

2 men at $6.50	$13.00
Wood, for thawing	2.00
	$15.00
Cost of sinking 6 ft.	$15.00
Cost per ft.	2.50

Tunnelling.—From the bottom of the shaft two men will drive a tunnel 6 feet by 4 feet by 3½ feet, in one shift, *i.e.*, thaw the ground and hoist the dirt in ten hours. (It is seldom necessary to timber shafts or tunnels for windlass work.) The cost of tunnelling by this method is estimated as follows:—

TABLE IX.

2 men at $6.50	$13.00
Wood for thawing	2.00
	$15.00
Cost of tunnelling 6 ft.	$15.00
Cost per foot	2.50*

* The shaft in this case was 30 feet in depth. The cost per foot would necessarily increase according to the distance from the bottom of the shaft.

Yukon No. 8

Construction showing rear gauntree of steel Bucyrus 7 cubit foot dredge

CHAPTER V.

DREDGING

DREDGING has rapidly developed in the Yukon as a highly profitable industry, and dredges are operating successfully not only in the beds and on the bars of rivers, but also on the frozen placer creek claims in the Klondike district. A short time ago the rich claims on the more prominent creeks in the Klondike district proper were being worked by the most modern methods of what is known as ordinary placer mining. Gravels, from which large quantities of gold dust were recovered by this method are now being worked by dredges adapted to the special conditions which exist in that district.

THE YUKON GOLD COMPANY.—This company is incorporated under the laws of the State of Maine, and commenced operations in the Yukon in 1906. The president of the Company is S. R. Guggenheim, the secretary-treasurer, Chas. K. Lipman, the consulting engineer and general manager, O. B. Perry, all of 120 Broadway, New York and the resident manager is C. A. Thomas, Dawson, Y. T.

The holdings of the company comprise 555 creek, hill and bench claims in the Klondike district:—

CREEK CLAIMS

Bonanza creek	214
Eldorado creek	42
Hunker creek	70
Bear creek	27
Gold Run creek	56
Dominion	1
Klondike river	4

HILL CLAIMS

Bonanza	48
Eldorado	10
Hunker	13
Klondike	10
Gold Run	4

BENCH CLAIMS

Bonanza	36
Eldorado	1
Hunker	11
Dominion	2
Klondike	6

Dredges were constructed by this company as follows:—

1. In 1906 on claim 105 below on Bonanza.
2. In 1906 on claim 105 below on Bonanza. In the fall of 1910 this dredge was moved to 58 below on Bonanza.
3. In 1907 on claim 90 below on Bonanza.
4. In 1908 on the Anderson concession. In the fall of 1913 this dredge was moved to 41 below on Hunker.
5. In 1909 on the Anderson concession. In 1910 this dredge was moved to 31 below on Bonanza.
6. In 1908 on claim 90 below on Bonanza. In the fall of 1913 this dredge was moved to 12 below Gold Run.
7. In 1908 on claim 36 below on Hunker. In the spring of 1912 this dredge was moved to Iditarod, Alaska.
8. In 1911 on claim 4 above Discovery on Bonanza.
9. In 1911 on claim 7 Eldorado.

A general description of the hull and equipment of one of the Yukon Gold Company's dredges, is as follows:—

GENERAL

Make of dredge	Bucyrus.
Number of years in commission	4.
Type of dredge	7½ cu. ft. close-connected bucket
Capacity of dredge, per day (actual)	5,042 cu. yds.
Power	300 K.W. electric.

HULL

Length	98′.
Width on water-line	36′—38′ 6″.
Depth	8′ 6″.
Draught	6′ 9″.

MECHANICAL EQUIPMENT

Weight of bucket	1,750 pounds.
Capacity of bucket	7½ cu. ft.
Number of buckets in line	70.
Design of digging ladder	Plate girder.
Length of digging ladder	80′.
Upper tumbler is	(2)—hexagonal and weighs 12,000 pounds.
Lower tumbler is	(2)—round and weighs 8,000 pounds.
Diameter of journals	8½″.
Dimensions of revolving screen	6′ inside.
Weight of revolving screen	20,000 pounds.
Length of stack ladder between centres of drum	89′.
Dimensions of conveyor belt	32″.
Weight of steel spud	30,000 pounds.
Dimensions of steel spud	24″ x 36″.
Dimensions of wooden spud	24″ x 30″.

The electric motor equipment installed has a rated capacity of 305 horse-power, distributed as follows:

Name of motor	H.P.	Speed (1)	R.P.M.	Volts
Main drive	100	Variable	580	400
Sluice motor	90	Constant	840	400
Prime pump	15	Constant	850	400
Winch	20	Variable	850	400
Screen	50	Constant	514	400
Stacker	30	Constant	850	400

Canadian Klondike Power Company's Power House, North fork of the Klondike river

Yukon No. 2
Wooden Bucyrus 5 foot dredge in operation

The power for operating dredges is obtained from the company's hydro-electric plant operated by water from the Little Twelve-mile river carried through five miles of flume and delivered to the plant under 650 feet net effective head. The installation consists of three 650 K. W. generators, directly connected to three water wheels of the impulse type. The main transmission line is 36 miles in length, operating at 35,000 volts, with 18.2 miles of extensions and secondaries.

Canadian Klondike Mining Company Limited.—The original company from which the present company has been evolved was incorporated under the laws of the Dominion of Canada in November, 1904, and commenced operations in August, 1905 on Hydraulic Mining Lease No. 18, which is known as the "Boyle Concession" on the Klondike river. J. W. Boyle, Dawson, Y. T. is general manager of the company.

Mr. Boyle states that the approximate area of dredging ground within the Boyle concession, insofar as physical conditions are concerned, consists of approximately six and three-quarters square miles, being the entire flat of the Klondike valley within the confines of the concession. It is estimated by the general manager that this area contains 250,000,000 cubic yards of material, of which approximately 120,000,000 cubic yards have been proven by drilling and sinking of shafts to contain values which will be profitable for dredging. Prospecting is still being conducted on the undeveloped portion of the concession, and there is every indication that approximately 50,000,000 additional cubic yards will prove vaulable, although at present insufficient prospecting has been done to positively establish the values.

Operations were commenced on the Boyle concession in August, 1905, with dredge Canadian No. 1, a 7½ cubic foot dredge, electrically driven with power developed with a steam driven turbo-generator plant of 400 K.W. capacity. Both dredge and power plant were erected on the flat of the Klondike valley directly opposite the mouth of Bear creek.

This dredge operated on the Boyle concession during the open season of each year from 1905 until 1912, inclusive. In the fall of 1912, dredge Canadian No. 1 was dismantled at a point on the Klondike valley about two miles below Bear creek. In the spring of 1913 this dredge was reconstructed on claim No. 21 below Discovery on Hunker creek and worked claims Nos. 22 and 22A below Discovery. The dredge then worked up stream on Hunker creek continuously during the open season of 1913 and 1914 and is now operating on claim No. 8, below Discovery.

A general description of the hull and equipment of dredge Canadian No. 1 is as follows:

General

Make of dredge	Manufactured by Marion Steam Shovel Co., Marion, Ohio.
Number of years in commission	10.
Type of dredge	Elevator dredge with close-connected buckets.
Capacity of dredge, per day (actual)	5,000 cu. yds.
Power	3-phase, 60-cycle, 440-volt (hydro) electric.

Yukon No. 4
Operating on Lower Hunker creek, Yukon Gold Co.

HULL

Length	100′.
Width on water-line	38′.
Depth	7½′.
Draught	4½′.

MECHANICAL EQUIPMENT

Weight of bucket	1,700 pounds.
Capacity of bucket	7½ cu. ft.
Number of buckets in line	67.
Design of digging ladder	Open truss girder type.
Length of digging ladder	78′.
Weight of ladder and fittings	45,000 lbs.
Upper tumbler is	Pentagonal.
Lower tumbler is	Hexagonal.
Diameter of journals	Upper 12″, lower 10″.
Dimensions of revolving screen	(Stripped type).
Length of stack ladder between centres of drum	90′.
Dimensions of conveyor belt	32″ x 190′.
Dimensions of steel spud	24″ x 30″ x 56′.

The electric motor equipment installed on dredge Canadian No. 1, is distributed as follows:

Name of motor	H.P.	Speed (1)	R.P.M.	Volts
Main drive	100	Variable	580	440
12′ pump	50	Constant	685	440
Ladder hoist	35	Variable	900	440
Swinging winch	30	Variable	900	440
Screen drive	30	Constant	850	440
Stacker drive	20	Constant	850	440
4″ pump	20	Constant	840	440
Stacker hoist	10	Constant	1120	440
8″ pump	50	Constant	685	440

Dredge Canadian No. 2, a 16 cu. ft. dredge, was erected in the summer of 1910 at a point on the flat of the Klondike valley about one mile below the mouth of Bear creek. This dredge was completed and commenced operating on the 4th of November, 1910, and continued operations until the 4th of December following. It was also operated continuously during the open season of each year from the spring of 1911 until the 10th of October, 1914.

A general description of the hull and equipment of dredge Canadian No. 2, is as follows:

GENERAL

Make of dredge	Manufactured by the Marion Steam Shovel Company, of Marion, Ohio.
Number of years in commission	5.
Type of dredge	Elevator, with close-connected buckets.
Capacity of dredge, per day (actual)	10,000 to 16,000 cu. yds.
Power	3-phase, 60-cycle, 2,200 volt (hydro) electric.

HULL

Length	130′.
Width on water-line	48′.
Depth	12′.
Draught	9′.

Bow gauntree of 7-foot steel Bucyrus dredge

MECHANICAL EQUIPMENT

Weight of bucket	4,600 pounds.
Capacity of bucket	17 cu. ft.
Number of buckets in line	68.
Design of digging ladder	Plate girder type.
Length of digging ladder	97′.
Weight of ladder and fittings	216,000 pounds.
Upper tumbler is	Hexagonal and weighs 38,000 pounds.
Lower tumbler is	Hexagonal and weighs 28,000 pounds.
Diameter of journals	Upper 20″, lower 17″.
Dimensions of revolving screen	(Stripped) diameter 9′ 9″, length 49′ 6″.
Weight of revolving screen	126,000 pounds.
Length of stack ladder between centres of drum	115′.
Dimensions of conveyor belt	Width 48″, length 238′.
Weight of steel spud	62,000 pounds.
Dimensions of steel spud	38″ x 54″—65′ long.

The electric motor equipment installed on dredge No. 2 has a rated capacity of 1045 horsepower, distributed as follows:

Name of motor	H.P.	Speed	R.P.M.	Volts
Main drive	300	Variable	345	2200
Ladder hoist	200	Variable	600	2200
Screen drive	150	Variable	600	2200
14″ pump	150	Constant	600	2200
12″ pump	75	Constant	600	2200
4″ pump	35	Constant	600	2200
Winch	50	Variable	600	2200
Stacker drive	50	Constant	600	2200
Stacker hoist	35	Variable	600	2200

Dredges Canadian No. 3 and Canadian No. 4 were constructed in 1912 and 1913.

Dredge Canadian No. 3 commenced operating on the 10th of May, 1913, and has since operated continuously during the open season of each year.

Dredge Canadian No. 4 commenced operations on the 20th of May, 1913, and since that time has operated continuously during the open season of each year.

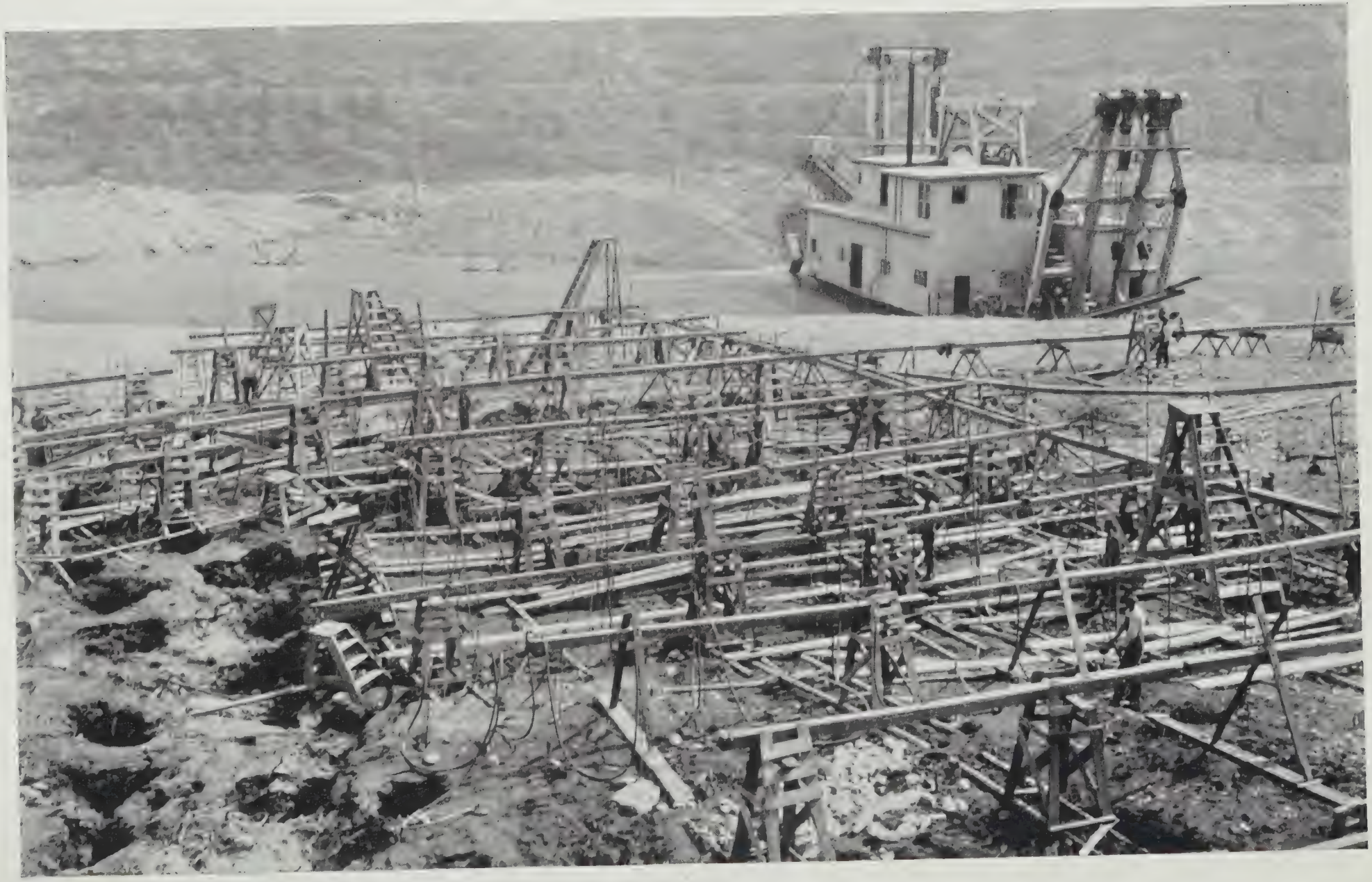
A general description of the hull and equipment of dredge Canadian Nos. 3 and 4, is as follows:

GENERAL

Make of dredge	Manufactured by the Marion Steam Shovel Co., Marion, Ohio.
Number of years in commission	2.
Type of dredge	Elevator dredge, with close-connected buckets.
Capacity of dredge, per day (actual)	10,000 to 16,000 cu. yds.
Power	3-phase, 60-cycle, 2,200 volt (hydro) electric.

HULL

Length	136′.
Width on water-line	56′ 6″.
Depth	Bow 14′ 6″, stern 12′.
Draught	8′ 6″.



Yukon No. 5

Operating on Bonanza creek. Equipment for thawing ground. Yukon Gold Co.

MECHANICAL EQUIPMENT

Weight of bucket	4,600 pounds.
Capacity of bucket	17′.
Number of buckets in line	68.
Design of digging ladder	Plate girder type.
Length of digging ladder	97′.
Weight of ladder and fittings	216,000 pounds.
Upper tumbler is	Hexagonal and weighs 38,000 pounds.
Lower tumbler is	Hexagonal and weighs 28,000 pounds.
Diameter of journals	Upper 20″, lower 17″.
Dimensions of revolving screen	(Stripped) diameter 9′ 9″, length 49′ 6″.
Weight of revolving screen	126,000 pounds.
Length of stack ladder between centres of drum	115′.
Dimensions of conveyor belt	Width 48″, length 238′.
Weight of steel spud	62,000 pounds.
Dimensions of steel spuds	38″ x 54″—65′ long.

The electric motor equipment installed on dredges Canadian Nos. 3 and 4 has a rated capacity of 1120 horse-power, distributed as follows:

Name of motor	H.P.	Speed	R.P.M.	Volts
Main drive	300	Variable	345	2200
Ladder hoist	200	Variable	600	2200
Screen drive	150	Variable	600	2200
16″ pump	150	Constant	600	2200
14″ pump	150	Constant	600	2200
4″ pump	35	Constant	600	2200
Winch	50	Variable	600	2200
Stacker drive	50	Constant	600	2200
Stacker hoist	35	Variable	600	2200

The Canadian Klondike Power Company Limited.—This company was formerly known as the Granville Power Company, Limited, and was incorporated under "The Companies' Act" of the Dominion of Canada on the 29th of April, 1910. The officers of the company are, president, James McDougall, secretary, A. E. Nash, and manager, J. W. Boyle.

The plant of the Canadian Klondike Power Company is situated on the Klondike river, twenty-six miles from Dawson. The manager states that twelve dredges have been supplied with power from this plant, and that the cost of power varies according to the quantity supplied, the highest price charged being 3 cents, and the lowest 2 cents per kilowatt hour.

Construction work was commenced in June, 1910, and the plant started generating power on the 6th of May, 1911. The following statement was furnished by the manager concerning:—(a) water grant and ditch, (b) equipment and (c) transmission lines:—

Water Grant and Ditch.—The water diverted for power purposes is obtained under authority of three water grants from the Canadian Government which provide for a total diversion of 30,000 miner's inches (equivalent to 45,000

Dredge Canadian No. 3 in operation. Canadian Klondike Mining Company, Limited

cubic feet of water per minute) from a point on the north fork of the Klondike river about four miles from its confluence with the main channel thereof.

The water is conveyed from the point of diversion by means of a ditch six miles in length.

The ditch is 18 feet in width at the bottom and 28 feet in width at the top, with a minimum depth of 5 feet. The ditch conveys the water to the hillside facing the main valley of the Klondike river, and is delivered to the water wheels through two lines of pipe graduating from 72 to 66 inches in diameter, each 1676 feet in length, and with an effective head of 228 feet.

Electric Plant.—Two 5,000 H.P., I. P. Morris reactionary turbines direct connected to two 3,000 K.V.A. Westinghouse alternators, 2,300 volts, 3-phase, 60 cycle, 514 R.P.M.

One 85 K.W. exciter, direct connected to a 36 inch Pelton impulse wheel.

One 85 K.W. exciter, direct connected to a 110 H.P. induction motor.

Two banks of transformers, each bank consisting of three 1,250 K.W., 2,300 volts to 33,000 volts, 60 cycle, water-cooled, single phase transformers, delta connected. Each transformer is housed in a separate concrete vault.

The switchboard is made up of six panels, on which are mounted all the necessary instruments and switching devices, including graphic recording volt meter, watt-meter, power factor meter, frequency meter and Tyrell regulator. All switches carrying over 125 volts are located in a concrete vault in the basement of the power station.

Transmission Lines.—There are two lines of transmission from the North Fork power station.

1. The Dawson line which runs to the city of Dawson, a distance of 22 miles from the power house, and supplies power to:

(a) Canadian Klondike Mining Company's large centrifugal pumping plant at the mouth of Hunker creek, at which point is situated a sub-station with 1,000 K.W. transformer capacity.

(b) Dredge Canadian No. 2, Canadian Klondike Mining Company's machine shops, and the main camp of the mining company are supplied through Bear creek sub-station which has 1,000 K.W. transformer capacity.

(c) Dredges Nos. 3 and 4 of the Canadian Klondike Mining Company's equipment, which receive power from Bonanza basin sub-station of 2,000 K.W. transformer capacity.

(d) The city of Dawson, for the purposes of the Dawson Electric Light & Power Company, Limited, and the Dawson City Water & Power Company, Limited, which furnish the city of Dawson with all power, light and water services (including fire protection service) all of which is electrically operated. This power is also furnished from Bonanza basin sub-station mentioned in subsection (c).

2. The Dominion line which runs to the head of Dominion creek, 20 miles distant from the power house. 14 miles out on this line there is a branch line 4 miles long to the Hunker sub-station of 300 K.W. capacity.

Stern view of dredge, Canadian No. 3

The transmission is phase, 33,000 volt. Wooden poles are used, which are 35 feet above ground and are spaced 32 to the mile. Lightning arresters are installed at the power house and at all sub-stations.

The plant employs a station foreman, two operators and two oilers. The Bonanza basin sub-station has a day and a night attendant. The other sub-stations are cared for by electricians in the employ of the dredging corporation using same.

An average of 4 men are employed in connection with the intake and ditch operations.

Approximately 1½ miles of the ditch are in gravel and 4½ miles through muck and glacial silt.

In order to retain the frost, during the summer months, for the greater stability of the banks, the lower bank of the ditch, excepting in gravel cuts, is faced with brush as a protection from the sun's rays.

As soon as the cold weather sets in and ice starts to form, the ditch is filled bank full, allowed to freeze over until a coating of from 18 inches to two feet of solid ice has formed—or sufficient to remain up in the form of a bridge—when the water is dropped two or three feet, leaving an air space between the bridge of ice and the surface of the water in the ditch.

Electric heaters are installed at the intake and at intervals of about two miles in the ditch and at the pressure box at the head of the pipe lines, through which approximately 90 K.W. of heat are used, enabling the plant to operate the entire year and through temperatures extending to 70° below zero; and in one instance operating through a week with average temperatures of over 60° below zero, without any difficulty.

The pipe line has been covered, there being a roof built for the upper part of the pipe, leaving an air space; the roof consisting of poles covered with about one foot of moss and one foot of gravel.

North West Corporation, Limited.—The following statement was obtained from the engineer of this company.—

The North West Corporation, Limited, is an English company which was formed in 1913 with an authorized capital of 1,500,000 pounds. Its holdings are within the Indian river watershed in the Klondike mining district, and consists approximately of 75 miles of valleys, which have been estimated to contain 600,000,000 cubic yards of gold-bearing gravels.

Overlying the pay gravels in the valleys is a heavy covering of overburden consisting of moss and muck cemented with ice. This overburden is a non-conductor, and prevents the underlying gold-bearing gravels from being thawed by atmospheric conditions.

Ground-Sluicing.—This company employs, on an extensive scale, the ground-sluicing method of preparing the valley ground for actual digging. By the use of surface and pressure water conveyed through canals and ditches to the ground being prepared, the moss and muck are worked off to the underlying gravels, and carried away in suspension to the main creeks and rivers. The underlying

Dredge, Canadian No. 3, in operation on Christmas day, 1913. Canadian Klondike Mining Company, Limited

gravels, being exposed to the sun's heat, soon thaw to bedrock. The greater the area treated the quicker the gravels thaw to bedrock, the depth of thaw each season varying from 10 to 16 feet in gravel.

Muck.—Muck overburden is a frozen substance having the following characteristics: Gray to black in color, composed of organic matter with particles of sand and silt cemented by ice. The temperature of frozen muck varies from 8 degrees to 12 degrees below freezing point.

Overburden removed in:—

	cu. yds.
1911	193,513
1912	588,280
1913	981,736
1914	1,544,141
	3,307,670

varying in cost from 2 cents to 8 cents per cubic yard.

DITCHES CONSTRUCTED AND BEING USED FOR GROUND-SLUICING PURPOSES

Dominion-Granville ditch, capacity 1,000 miners' inches, length 14 miles.
Burnham-Jensen ditch, capacity 600 miners' inches, length 8.25 miles.
Caribou-Nevada ditch, capacity 3,000 miners' inches, length 8 miles.
Quartz creek ditch, capacity 1,000 miners' inches, length 7 miles.
Other ditches, 15 miles.
Average number of men employed during the summer season, 140.

North American Transportation & Trading Company.—This company has a dredge of the Risden type, steam driven, open bucket line, and a bucket capacity of 5⅓ cubic feet, operating on Miller creek. This dredge was built on Walkers fork in the year 1907, and was moved to Miller creek during the winter of 1912. The agent of the company states that prior to the installation of the dredge, a considerable area of ground was thawed to bedrock by the method of ground-sluicing, and that the quantity dredged in 1914 was 218,447 cubic yards.

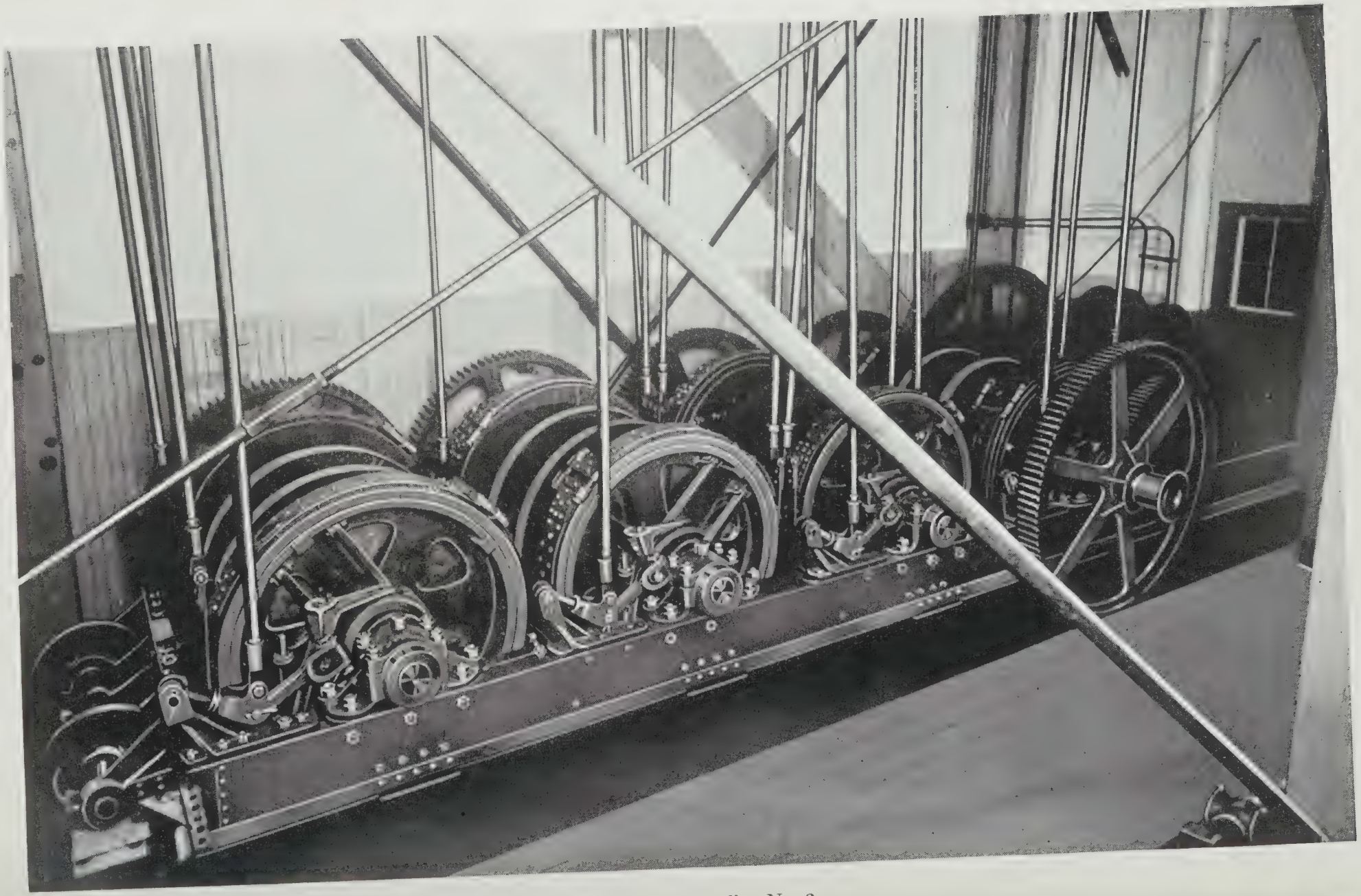
NOTES ON DREDGE CONSTRUCTION

From experience gained by the Canadian Klondike Mining Company in connection with No. 1 dredge, alterations were made on dredges Nos. 2, 3 and 4, for the purpose of overcoming the difficulties of operating in cold weather, and the result is that these dredges have been operated without difficulty through temperatures exceeding 50 degrees below zero, and have lengthened the dredging season (which was formerly accepted as being about 150 days per season) to about 240 days during an ordinary season. A record operation of 270 days was made by Canadian No. 2.

The principal alterations made to effect this change were:—

(a) Construction of a box girder type digging ladder with raised sides and a heating compartment in the ladder to prevent ice from forming thereon.

(b) Tailing stacker built in the form of a box girder with the return rollers placed inside of (instead of underneath) the stacker, the whole being enclosed



Winches. Canadian No. 3

during cold weather with canvas housing stretched over steel angle arches. The interior of this is steam heated, and the only exposure of the belt to cold weather is where it passes over the drum at the outer end of the stacker.

(c) The construction of a carefully built double boarded house enclosing all machinery and stairways, steam heated throughout by means of a 70 H.P. boiler installed within the hold of the dredge, from which hot water is used to keep ice from forming on the exposed sheaves in use on the bow of the dredge.

Owing to the difficulty experienced in handling heavy pieces of machinery on board the dredge first constructed, alterations were made in dredges Nos. 3 and 4 by erecting an overhead framework upon which a 20-ton travelling crane is operated, thereby eliminating all doors in the sides of the dredges, access to the dredge for the purpose of removing or installing machinery being had through hatchways in the roof of the housing. This structure extends 16 feet beyond the bow gauntree so that any piece in use on the dredge can be picked up on the shore by the crane, carried aboard, and placed directly over the machine to which it belongs, with the exception of parts of the winches and ladder hoist.

In operating dredge Canadian No. 2, the hull of which, like all other conveyor type dredges, was built in the form of a box, it was found that the increase in the weight of machinery at the bow had been disproportionate to that of the washing plant. The result was that the dredge was down at the bow to such an extent that it interfered with the proper washing of the material on the tables, owing to the loss of grade in the stream-down sluices. The design of the hulls of dredges Canadian No. 3 and Canadian No. 4 was therefore altered, so that instead of being 12 feet in depth throughout, as in the case of Canadian No. 2, these dredges were constructed 12 feet in depth at the stern and 14 feet 6 inches at the bow.

Instead of using a single steel digging spud, and a wooden spud for stepping on, all three of the 16 cu. ft. dredges were equipped with two steel digging spuds placed as close together as the width of the trailing stacker would permit, and as a result no loss in time was sustained in stepping forward. This altered the system in vogue on other dredges of dropping the wooden spud and swinging the entire width of the pond for the purpose of moving the dredge forward.

Bucket-Line.—The bucket-line is the most important part of a dredge and is the most expensive both in initial cost and in maintenance. There are two types of bucket-line, namely, open-connected and close-connected. In the open-connected there is alternate bucket and link and in the close-connected no link intervenes. The original idea of an open-connected bucket was that it would dig better in hard ground and in soil containing large boulders, but nearly all modern dredges use the close-connected bucket-line.

The bucket includes a bottom or back, a hood and a lip and these are fastened together with a pin and bushings. Buckets differ greatly in shape. The chief difference being in length of pitch, angle of lips, depth and width.

Dredge, Canadian No. 4, operating in the Klondike river. Canadian Klondike Mining Company, Limited

A bird's eye view of the valley of the Klondike from the mouth to Bear creek

The general manager of the Canadian Klondike Mining Company has furnished the following information concerning the construction of buckets in his company's dredges:

The bucket is cast in a single piece insofar as the bottom or base and the hood are concerned, and except where there is a flaw in the casting it has a minimum life of about 600 days. Both high-carbon steel and manganese have been used in the construction of buckets. Where high-carbon steel is used an inserted plate of manganese steel is placed just back of the lower end or single eye of the bucket where it is subjected to the greatest wear, in order that this part may be renewed when the bucket wears down. This practice was found unsatisfactory, however, and since 1912 in all buckets constructed for the company's use manganese steel has been used.

The lip is composed of manganese steel, 2¾ inches in thickness, and 16 inches deep, with an average life of from 180 to 200 days.

The buckets for the 16-foot dredges have given considerable trouble due to the enormous amount of friction on the pin and bushing, and after many experiments the company adopted the use of manganese steel throughout, that is, manganese buckets, pins and bushings. The size of the pin has also been increased from its original diameter of 7 inches to 7½ inches, using a hollow cast manganese steel pin which is now giving satisfactory results.

The bucket lip originally installed was 2¼ inches thick by barely 14 inches deep, of which approximately 10 inches were available for wear, since, when this portion was worn off, it became a matter of economy to discard the unworn part and instal a new lip.

In 1914 an alteration was made by increasing the thickness of the lips ½ inch, and the height approximately 2½ inches in the middle, and in addition to the longer life and smaller percentage of waste in these lips they stand up much better under severe service, as the first lips in some instances gradually bent in the middle. The alteration of the lip in this manner has increased the carrying capacity of the buckets from 16.1 cubic feet to about 17.2 cubic feet.

The principal difference between the shape of the buckets used by the Canadian Klondike Mining Company and those of other companies is that the former are for the most part more rounded on the lip and have less pitch, with slightly more angle to the lips, which has the effect of preserving a thicker cutting edge.

Bucket pins for the 16-foot dredges are composed of manganese steel; are 7½ inches in diameter, and vary in weight from 350 to 400 pounds. There are generally 68 buckets in a line, but the number varies from 67 to 71 depending upon the depth at which the dredge is digging.

Tumblers.—The tumblers are the heavy castings at each end of the bucket-line and around which the chain of buckets revolves. In discussing the number of sides in a tumbler, Weatherbe, in "Dredging for Gold in California" observes:-

"The question of increasing the number of sides in tumblers so that they more nearly approach a circle in section has been discussed many times, and the

Bucket line, Canadian No. 3

question has now been pretty well settled by practical experiment. The number of sides must remain limited for two reasons:

1. In the case of the upper tumbler, after increasing the number of sides to six, its essential duty of holding, pulling round and dumping the bucket-line is impaired and no practical solution in the shape of a sprocket arrangement, any more than is now formed by the lugs and bottoms, as has been suggested, has been evolved; nor is it likely to be, on account of the immensly increasing weights and consequent strains set up.

2. The objection to the lower tumbler-section being increased to more than six or seven sides as a limit, is chiefly on account of the slippage and consequent wear."

The chief considerations that control the shape of the upper tumbler, however, are those which make for the most efficient and thorough emptying of buckets when dumping into the screen-hopper, and the least wear on pins and bushings. To aid this, jets of water are often used, playing into the full bucket as it rotates over the upper tumbler.

The general manager of the Canadian Klondike Mining Company Limited, states that his company's dredges have 6-point tumblers protected with manganese steel wearing plates at all points where they come in contact with the buckets, in addition to which the lower tumbler has a manganese steel tip wearing plate on each point, and the entire outside of the cheeks of the tumbler is sheeted with manganese steel wearing plates, which are replaced when necessary.

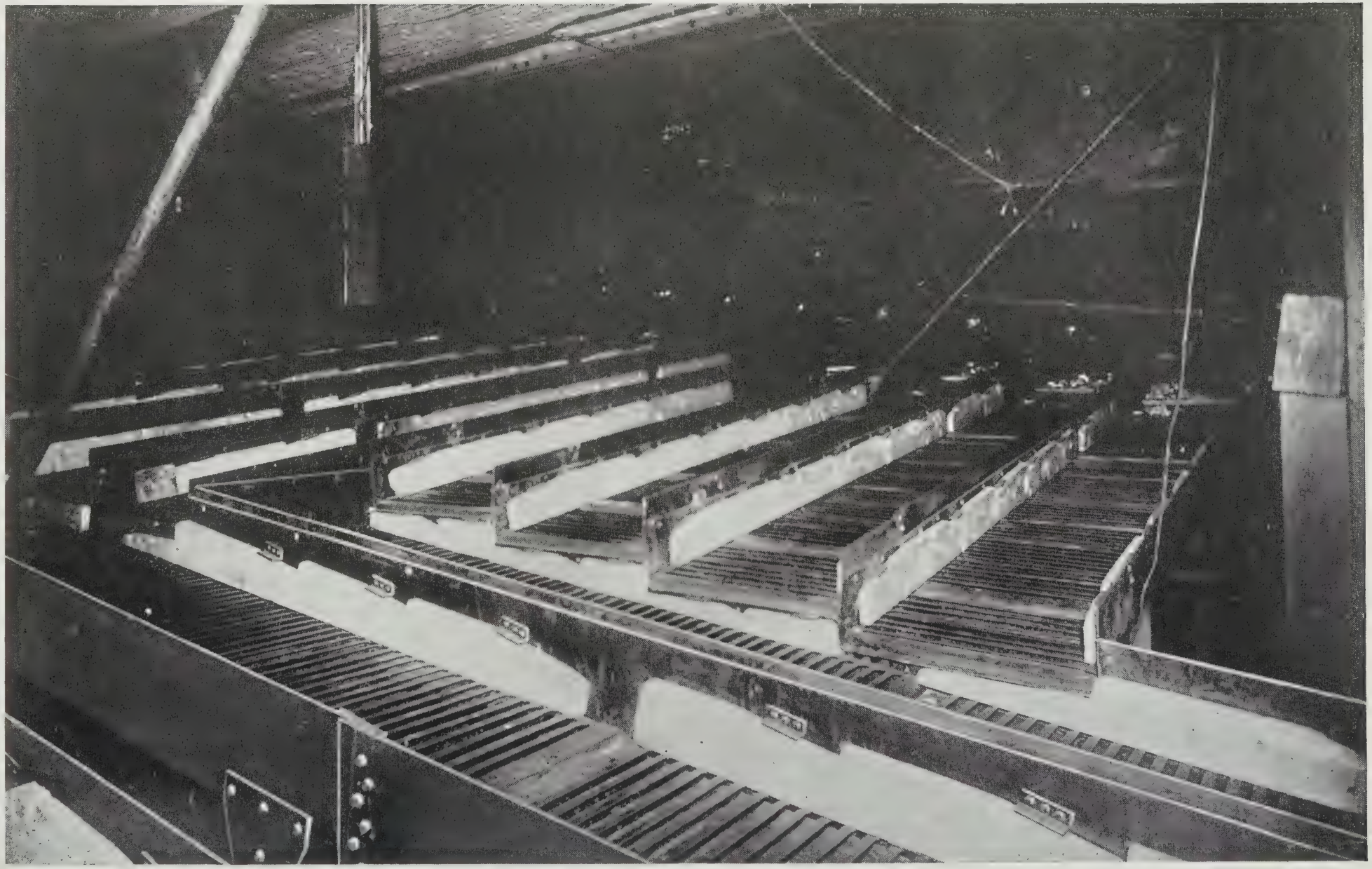
All wearing plates on tumblers are designed with a view to wearing through an operating season, which with the company, is approximately 240 days, for the purpose of avoiding lost time during the operating season, and new plates are installed during the general repairs, which are executed in March and April of each year before starting the season's operations.

Bow Gauntrees.—The bow gauntrees installed on the dredges of the Canadian Klondike Mining Company are constructed of timbers fortified at all joints with steel plates, using a steel box girder type cap. The gauntrees are almost identically the same as those in use on large dredges in California. The stern gauntrees are constructed along the same lines as the bow gauntrees insofar as fortification is concerned, steel cap being used, and are similar to gauntrees in use in California.

"Gold Dredging in California" contains the following information on the subject of gauntree construction:

"The dredge hulls built during the last five years have greatly increased in weight, and are strongly braced with two overhead trusses extending the entire length of the boat on either side of the well-hole; also an overhead truss across the hull in the centre, which is attached to and distributes the loads upon the tumbler gauntree, thereby stiffening the hull fore and aft and athwartships. These trusses generally consist of 14 by 14-inch posts, having 14-inch by 16-inch cap stringers, and are braced by heavy steel diagonal truss rods between the posts."

Looking up the Klondike river from Ogilvie bridge showing dredge, Canadian No. 4



Gold saving plates, Canadian No. 3

"To prevent the forward pontoon sections on either side of the well-hole from warping and sagging, which was a fault of the earlier boats, the bow gauntrees have been stiffened and redesigned to form a truss. The gauntree now consists of four posts 14 by 20-inches, rising about 36 feet above the deck, two being located on either side of the well-hole and two on the outside of the bow, well braced with steel rods and timber struts."

The middle or tumbler gauntree posts are 16 by 20 inches and of sufficient length to support the upper tumbler at a height of 23 to 25 feet above the deck. The stern gauntree posts are 14 by 16 inches and rise about 50 feet above deck resting on heavy timbers inside the hull.

The gauntree caps for the 5-cubic-foot and 7-cubic-foot machines are usually of timber, with steel side-plates the full length of the caps and extending down the gauntree posts, giving a substantial fastening to same. The larger machines are provided with structural steel caps.

Main Drive and Upper Tumbler.—The main drive, like all other machines on the 16-foot dredges of the Canadian Klondike Mining Company, is direct connected, the upper tumbler being driven by a 300 H.P. motor located on the main or upper tumbler gauntree, which is built of timber and heavy castings. These castings support the upper tumbler shaft, the two intermediate driving shafts, the ladder suspension shaft, and also the bow gauntree guys. The castings are so constructed as to form when bolted together and connected with a large cast-steel plate that forms the foundation for the main drive motor, a solid bed plate for the entire drive.

The motor is mounted on the cast steel bed plate above mentioned and geared direct to the tumbler by means of a train of steel spur gearing, all gears having cut teeth. The upper tumbler shaft is 25 inches in diameter, reduced to 18 inches in diameter at the bearings, which are 30 inches long and hollow bored. The main drive gears are 14 feet in diameter, with a 12 inch face.

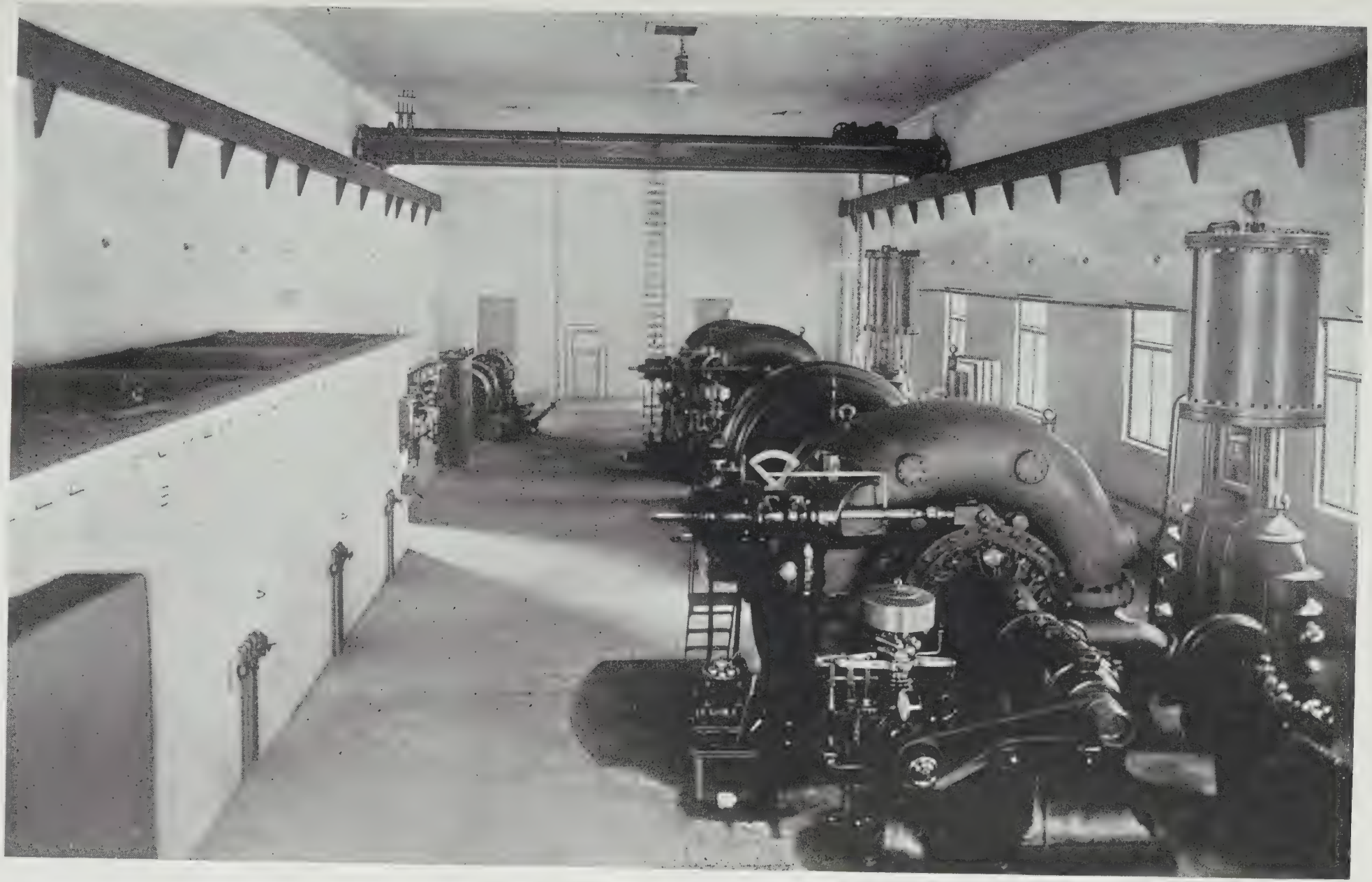
The second intermediate shaft is 14 inches in diameter with bearings 24 inches long. The intermediate gears are 91½ inches in diameter with 10 inch face, and the pinions meshing with the main gears are 26 inches in diameter.

The first intermediate shaft is 10 inches in diameter, fitted with a pinion at each end and near the middle carries a gear meshing with the pinion on the motor shaft. A friction clutch is mounted on this shaft for disengaging the motor and also acts as a slipping device.

Equalizing Gear.—The following information respecting equalizing gear was furnished by the Canadian Klondike Mining Company:—

The equalizing gear consists of bushing firmly keyed at quarters into the hub of the intermediate gear, this bushing at one end of the shaft being firmly keyed to the shaft, while at the other end two flat-backed keys are driven back to back, one into a key-way in the shaft, the other into a key-way in the bushing. These keys being 4 inches wide on the face, 1½ inches thick and 24 inches long.

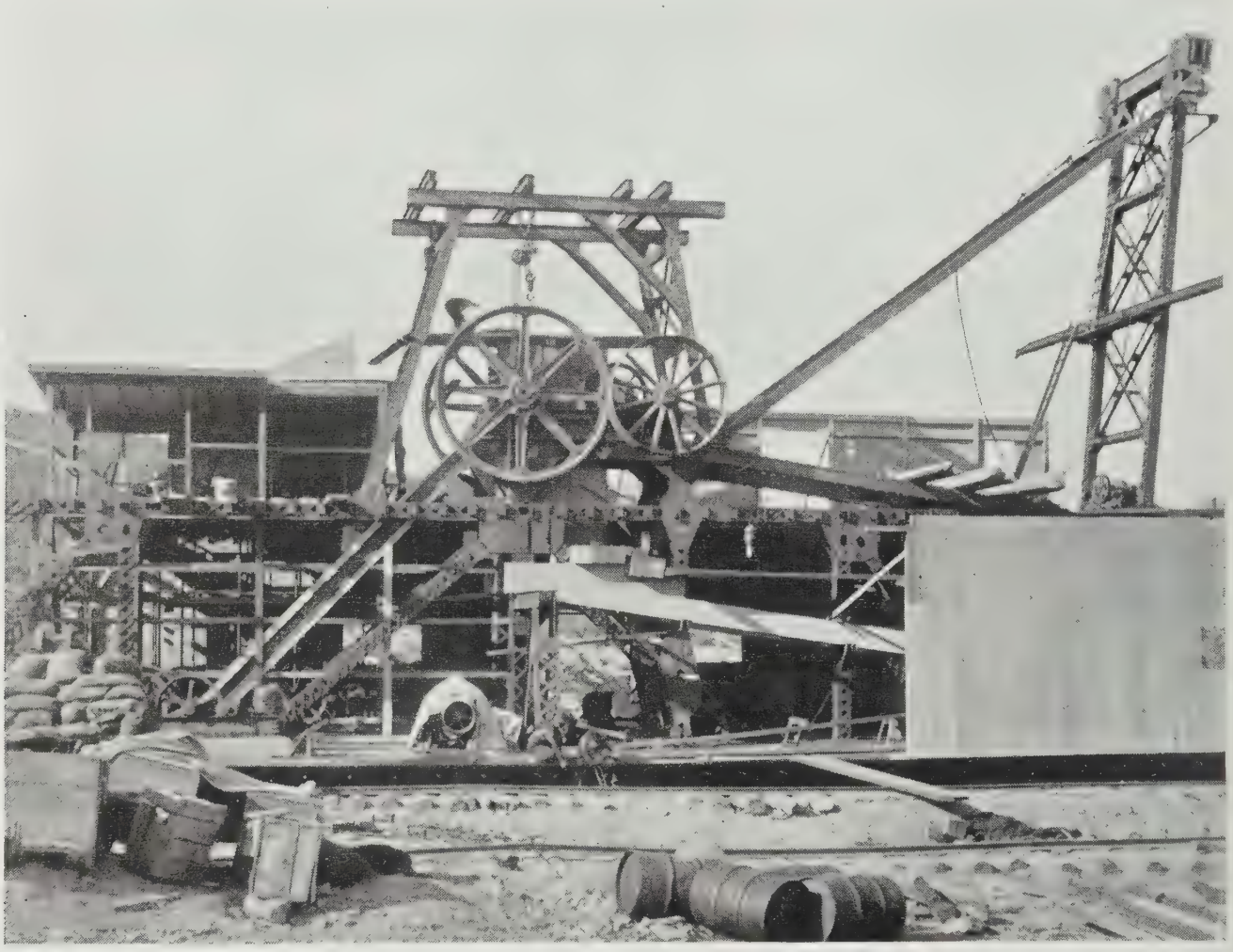
Ground sluicing, Lower Dominion



Interior of Canadian Klondike Power Company's Power House, North fork of the Klondike

The gears are set as nearly perfect as possible and any slight inequality will adjust itself through the small allowance of slip by the keys and insures a perfect mesh of the gears on both ends of the shaft.

Belts.—The belt conveyor stacker of the 16-foot dredges is 48 inches wide by 238 feet long. The stacker is 115 feet in length. A straight idler is used with small idlers set at an angle at either end thereof, so as to create a concave



Yukon No. 9
Construction, steel, 7 cubic foot dredge

form in the belt when running throughout the entire length of the stacker while carrying material, the driving drum on the other end of the stacker being straight and the belt returning on straight idlers.

The Canadian Klondike Mining Company use belts consisting of 8-plys of canvas with a convex reinforcement of rubber $\frac{5}{16}$ths of an inch thick in the middle. When the belt shows appreciable wear in the middle, a 30-inch 7-ply rubber belt is attached in the form of a pad belt, which while running over the same drum on the outer end of the stacker has a separate idler set up on brackets at the lower end, same being separately adjustable, thereby insuring continuous running in the middle of the main belt.

The belting used by the Yukon Gold Company is 32 inches wide, 7-ply; upper side has coating of $\frac{3}{16}$ inches of rubber over 24 inches in the middle of the belt, tapering to $\frac{1}{8}''$ on edges. The average life of a belt is the period involved in handling about 1,000,000 cu. yds. of material.

From the Canadian Klondike Mining Company, the following information has been obtained respecting: (a) cleanup, (b) materials resulting from

Winch Room. Dredge, Canadian No. 6

cleanup, (c) melting, (d) gold saving devices, and (e) treatment of black sand:—

Cleanup.—The gold saving system consists of a set of tables, made in the form of sluice boxes placed side by side on the foundation extending the entire length of the perforated portion of the screen, from the middle of the boat to each side, delivering into sluices running fore and aft and extending (in the case of the 16-foot boats) 30 feet beyond the stern.

At the head of the tables, on both sides of the screen, the first 42 inches of each sluice consists of a cocoanut mat on which is laid an expanded metal riffle, held firmly in place with wooden wedges. Below this set of riffles all sluices are fitted with angle-iron riffles with the angle bent slightly beyond 90° for the purpose of creating a riffle at each angle.

The cocoanut mats are taken up each morning and replaced, which operation takes from seven to fifteen minutes, and is performed during the period in which the crew are oiling the lower tumbler, thereby causing no lost time.

A general cleanup takes place whenever the angle-iron riffles become filled to an extent which would in any way interfere with their ability to save gold, and in consequence the periods at which these cleanups occur vary from once a week to twice a month, and are to some extent influenced by the question of repairs.

Immediately after the mats are changed and the oiling is completed, the dredge starts operating, and the clean-up crew proceeds to wash the mats in the tubs set up on each set of tables, piling the mats on a platform prepared for the purpose, ready to replace on the following morning those then in use. The material washed from the mats is run through a long-tom suspended from the ceiling over the tables, and over two sets of under-current riffles, the tailings from which are returned to the sluice tables of the dredge.

The long-toms are fitted with small cocoanut mats and expanded iron riffles, exactly similar to those installed at the head of the sluice tables, and after the material collected on the mats has been run through the long-tom, these mats are rolled up and taken to the cleanup room at the camp where they are washed, and the gold panned and blown, after which it is melted into small bricks for shipment to the mint. The tailings from pannings and blowings are amalgamated in a muller or grinding barrel, and when fully charged, the amalgam is retorted and the gold melted into bricks.

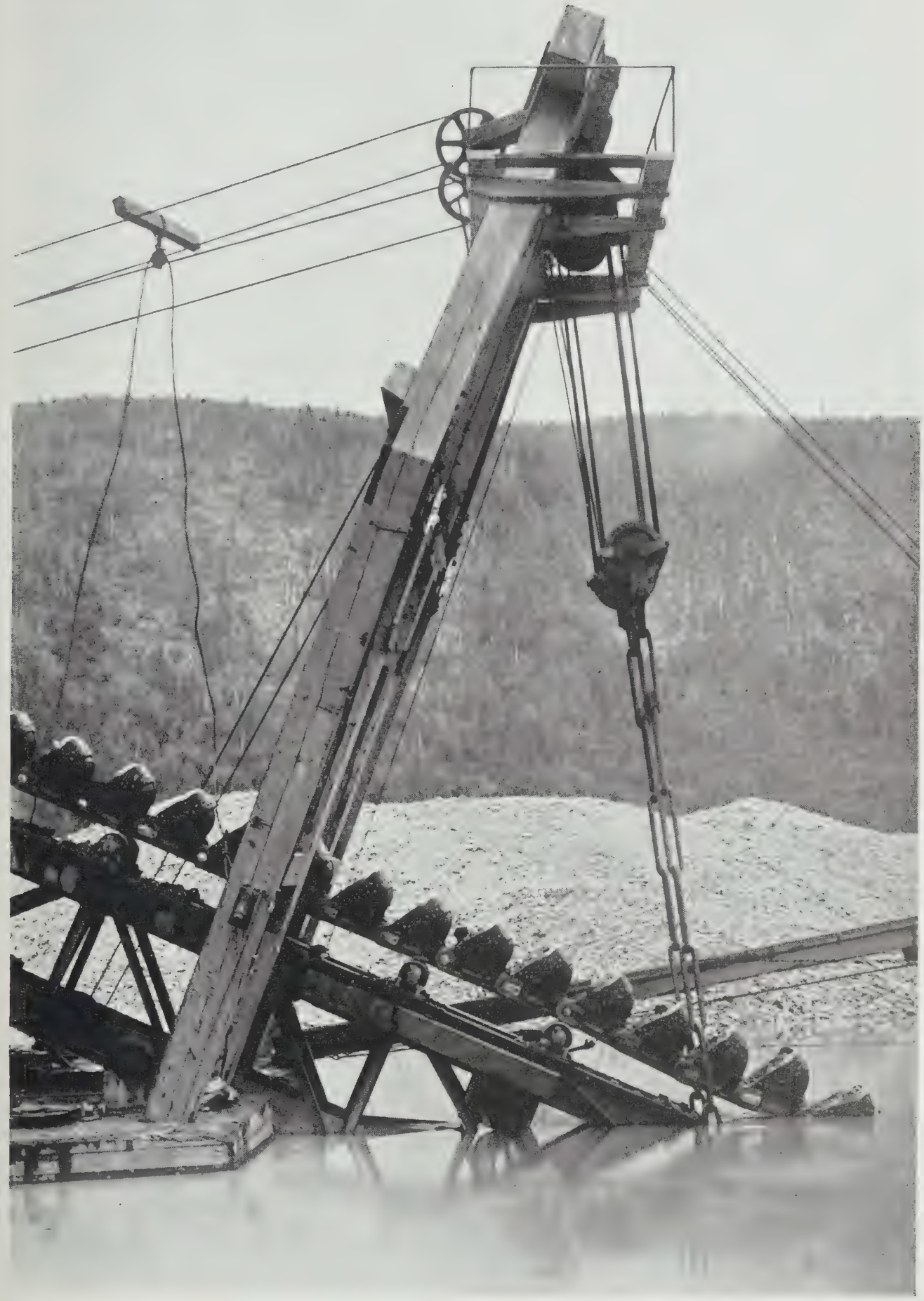
All sluices running athwart-ship on the dredges are 30 inches wide, stream-down sluices vary in width depending upon the number of athwart-ship sluices delivering into them, all sluices having a grade of 1½ inches to the foot.

Materials Resulting from Cleanup.—With the exception of the silver contained in the particles of gold recovered, no material of value has been found in the cleanup. A careful analysis was made of concentrates by fire assay and chemical and physical tests, and it was found that practically all of the gold was free; that the pyrites carried scarcely any gold; that the non-magnetic material consisted largely of quartz and ordinary alluvial rocky matter; and that the material which sank in bromoform consisted largely of cubes and fragments of yellow iron pyrites free from copper or arsenic. Small quantities of zircons were also found. No fluor-spar was found. No topaz was found either by chemical tests or microscopic examination, and it was decided that, with the exception of the gold, the material carried no commercial values.

Melting.—The treatment of gold dust is very simple as no attempt is made at refining the product, all of which is shipped to the Canadian mint.

The gold is melted in a plumbago crucible, the ordinary small open top furnace with gasoline jet being used. A flux of sodium carbonate (one part) and borax glass (two parts) is used and the melted gold skimmed with a small iron skimmer and poured into small bricks, which are then shipped by mail.

Efficiency of Gold Saving Devices.—It is impossible to say exactly what loss occurs in the process of winning the gold, but on one occasion it became necessary



Yukon No. 2
Bow gauntree and bucket line of 5-foot dredge

to dig through a considerable quantity of tailings already deposited by the dredge. Before entering the tailings the dredge was thoroughly cleaned and again carefully cleaned after reaching the other side. The recovery amounted to almost exactly $\frac{1}{10}$ of 1% of the amount recovered by the dredge when previously digging the same ground in its virgin state, and as nearly all of the gold recovered from the tailings was coarse it was assumed that it was gold which had passed through the dredge in chunks of bedrock which had been practically pulped

Yukon No. 8
Showing ladder construction Bucyrus, 7 cubic foot

together by the bucket lips in digging. At this particular place the bedrock consisted of decomposed schist, carrying considerable graphite, which when dug closely resembles clay and in many instances did not disintegrate on the screen. In consequence any gold contained within lumps which did not disintegrate, would be carried out on the stacker, but as this particular bedrock when exposed to the weather for a season dries out, decomposes and washes readily, any gold which it contained would then be recovered.

Tests of tailings have been made by catching a tub of fine material from the stream-down sluices at the stern of the dredge, where they are returned to the pond, and with the exception of an occasional very fine color, no gold has been

recovered, and in nearly every instance, although great care was taken in the panning, no recovery was made.

Treatment of Black Sand.—The black sand, and the very fine flour gold from which it is impossible to separate it by means of ordinary precipitation, are treated in a cleanup barrel or muller, which has a cement bottom, with a three-tooth grinder, the material being heavily charged with quicksilver and allowed to run for several hours, after which the amalgam is removed, retorted and the gold melted as already described.

Bucket with pin and bushing on dredge of Canadian Klondike Mining Company, Limited

The following notes were also obtained from the Yukon Gold Company on the subject of the treatment of materials resulting from cleanup:—

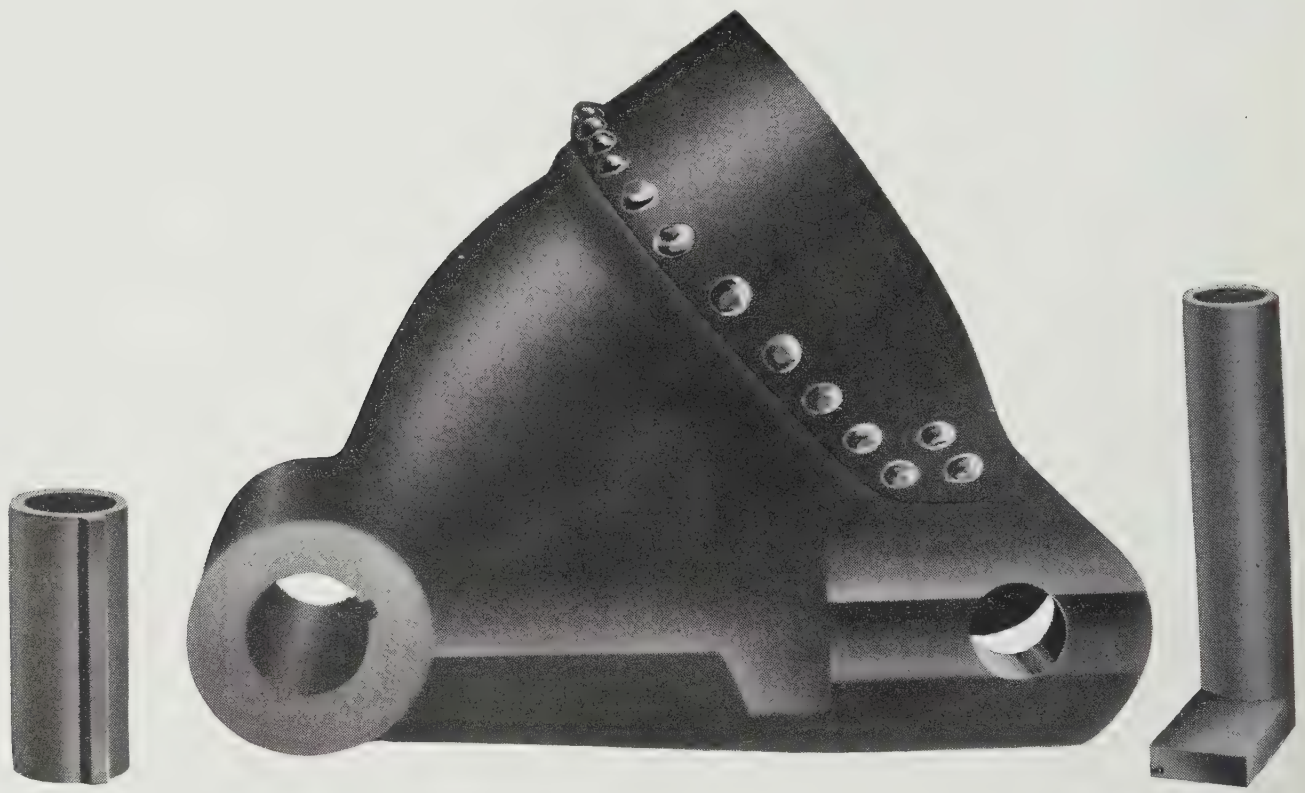
Clean amalgam is retorted directly and the quicksilver returned to the dredges. Cast-iron tube retorts holding five cast-iron-pans and heated by wood fire in a special brick furnace, are used. The retorted cake gold is broken by hammer and placed in a crucible heated in a gasoline furnace. The molten gold is poured in bricks, cleaned and weighed. Sampling is done by drilling and assaying by usual method.

Concentrates are amalgamated by putting them into a large cast-iron barrel with iron balls and revolving same for several hours. Water and sodium amalgam in quantity are present, and by this means the gold and lead are thoroughly amalgamated. This barrel then discharges slowly into a sluice through which water is pumped. The amalgam, lead, nails and iron remain in the sluice. These are removed, screened and washed, after which the gold grains sink in

quicksilver, and the base metals float. The two are separated and treated separately resulting in gold bullion and base bullion.

Working Costs

Dredges are operating in the Yukon river in the beds and on the bars of the Klondike river, and also on placer claims on Bonanza, Eldorado and Hunker creeks. Owing to the difference in the character of the ground, even in the same locality, dredges of the same make and bucket capacity may show entirely different working costs even under the same management.



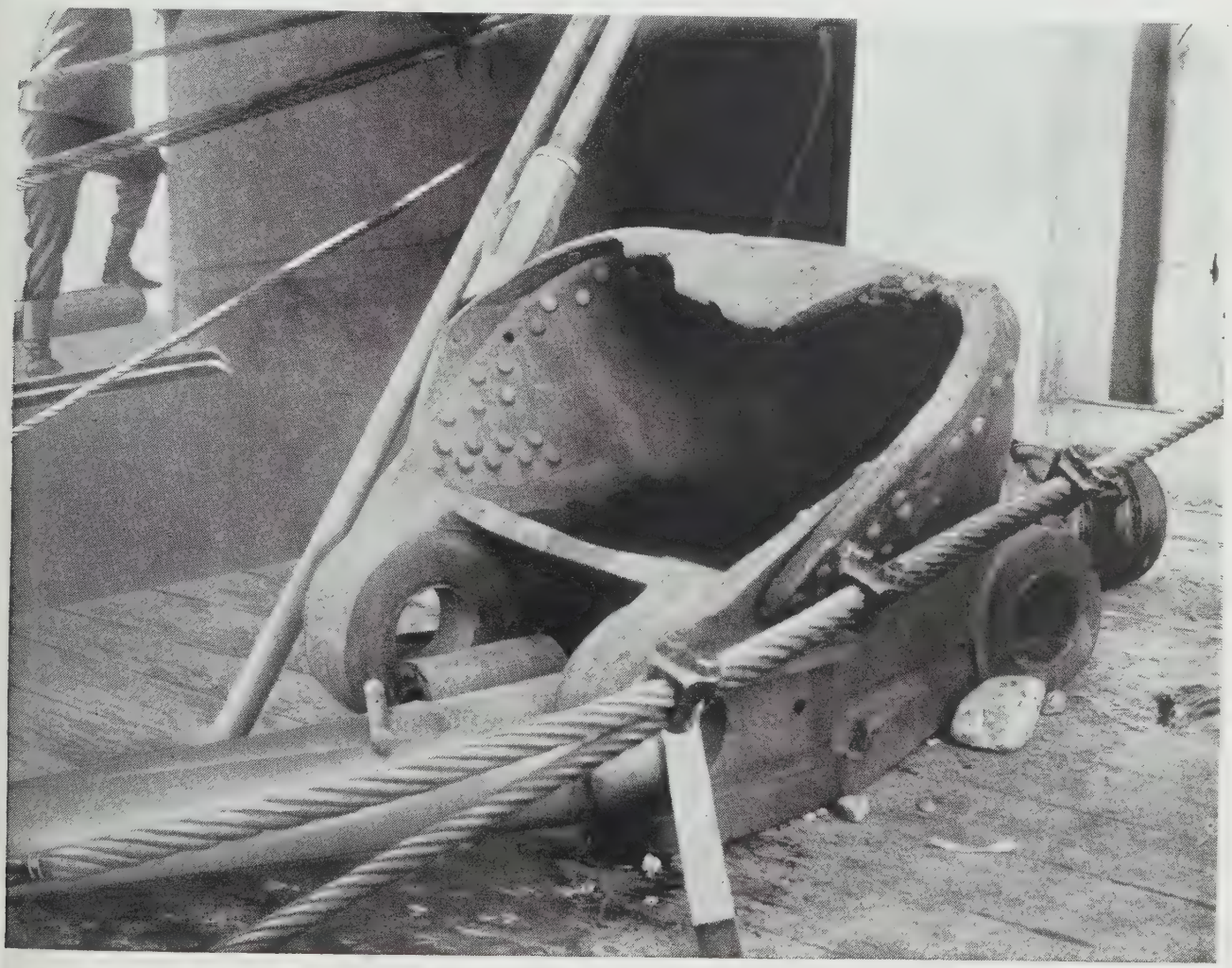
Side view of bucket with pin and bushings on dredge of Canadian Klondike Mining Company, Limited

Having determined the values which the property contains, the prime factor in dredging is to handle a maximum quantity of material in a given time. To accomplish this necessitates the highest percentage in working time.

DREDGING COST PER CUBIC YARD

The following figures represent the operating cost of the Yukon Gold Company's eight dredges operating on Bonanza, Eldorado and Hunker creeks for one season. The yardage totalled 5,133,575 cubic yards, which produced $3,343,667, or an average of 65.3c per cubic yard. The average cost, including depreciation, was 29.53c per cubic yard made up as follows. Of the area dredged 68.4% was frozen and had to be thawed by steam.

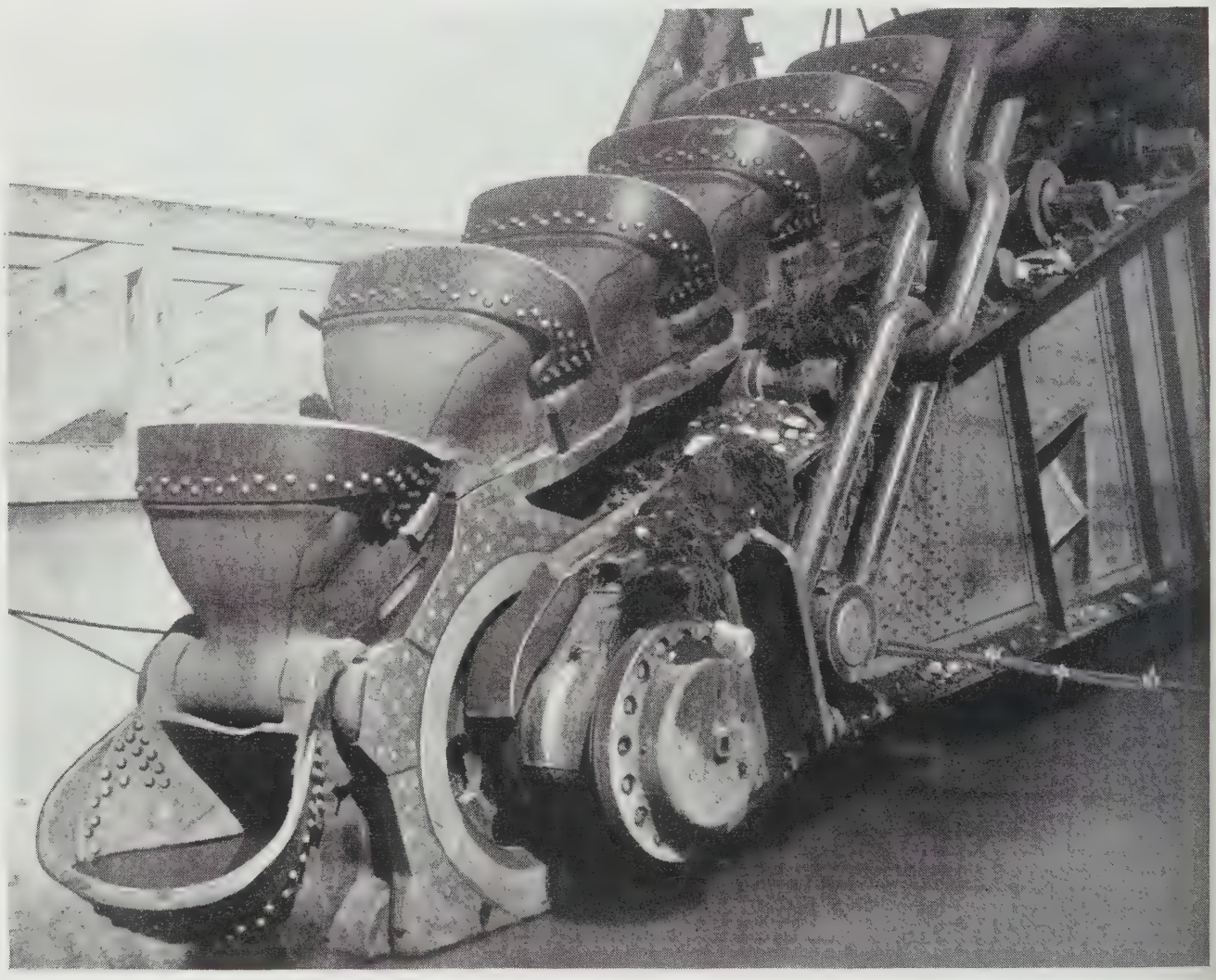
Fixed salaries	
Labour	$0.0008
Fuel	.0238
Shop expense (repairs)	.0009
Material and supplies	.0174
Power	.0246
	.0021
Total direct	$ 0.0696
Preliminary (accumulated during closed season)	
Taxes (renewal of grants)	$0.0228
Bullion charges (mint refinery and government gold tax)	.0005
General charges	.0198
Depreciation	.0185
Insurance	.0183
Assay office	.0012
Stables (hauling)	.0013
Maintenance and depreciation company's telephone lines	.0021
Transportation	.0003
Miscellaneous	.0001
	.0051
Total indirect	$0.0900
Thawing	
Total operating cost	$0.1357
	.2953



Worn out bucket

Following table shows the percentage of lost time of the Yukon Gold Company's fleet of 8 dredges operating on Bonanza and Hunker creek. Figures cover an operating season.

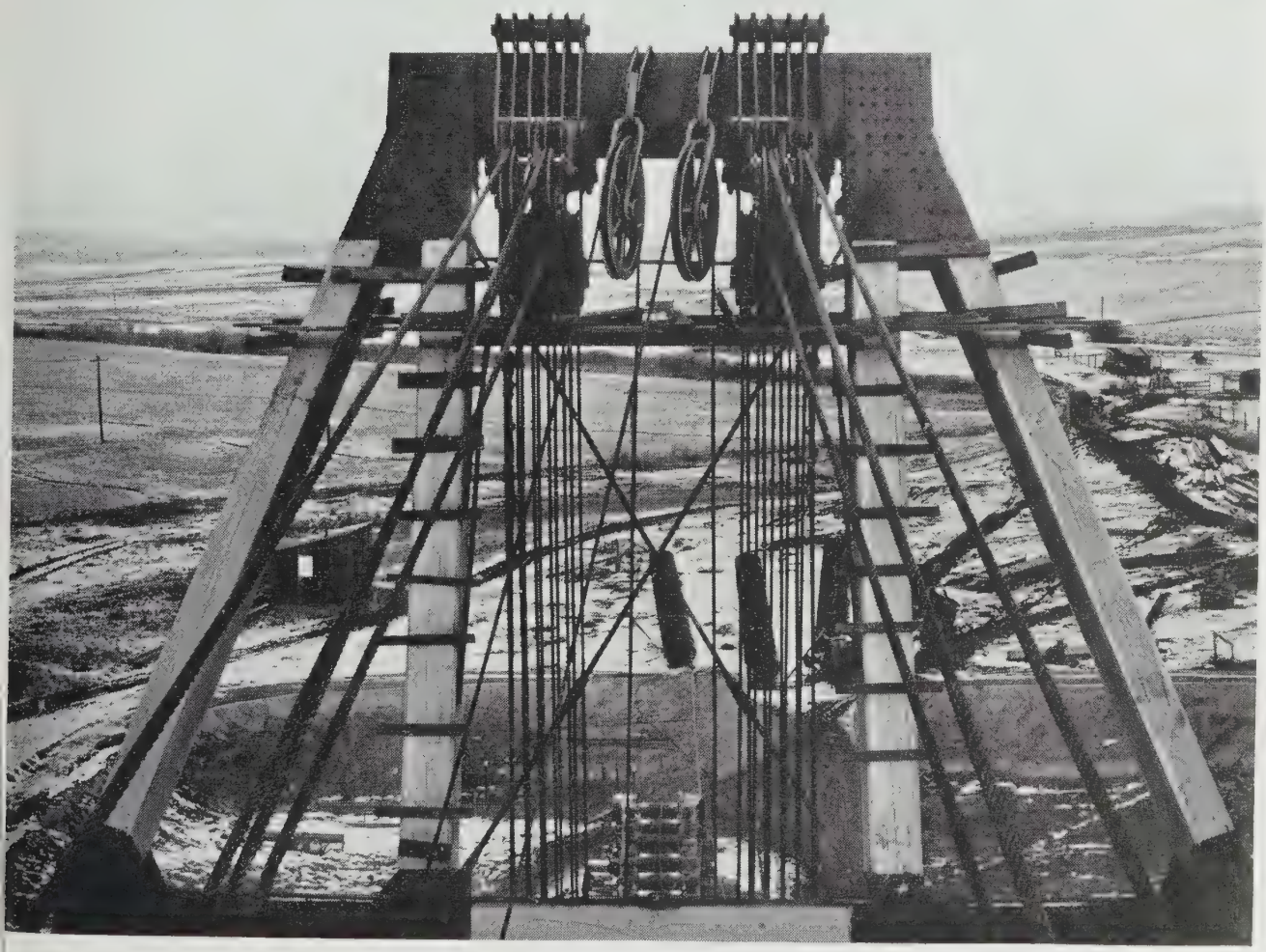
Ladder	2.76
Bucket line	3.87
Tumblers	6.46
Screens	11.02
Spuds	1.10
Stacker	3.30
Sluice pump	1.92
Sand pump	0.00
Winches	3.25
Lines	5.60
Motors	2.10
Power	5.50
Stepping ahead	23.20
Moving over	6.92
Clean-ups	8.70
Other causes	14.30
	100.00
Running time	86.15%
Lost time	13.85%



Digging line, showing close connected buckets, lower tumbler, and ladder suspension chain, on dredge of Canadian Klondike Mining Company, Limited

The following table shows the percentage of lost time of a dredge for one year's operation on Bonanza creek.

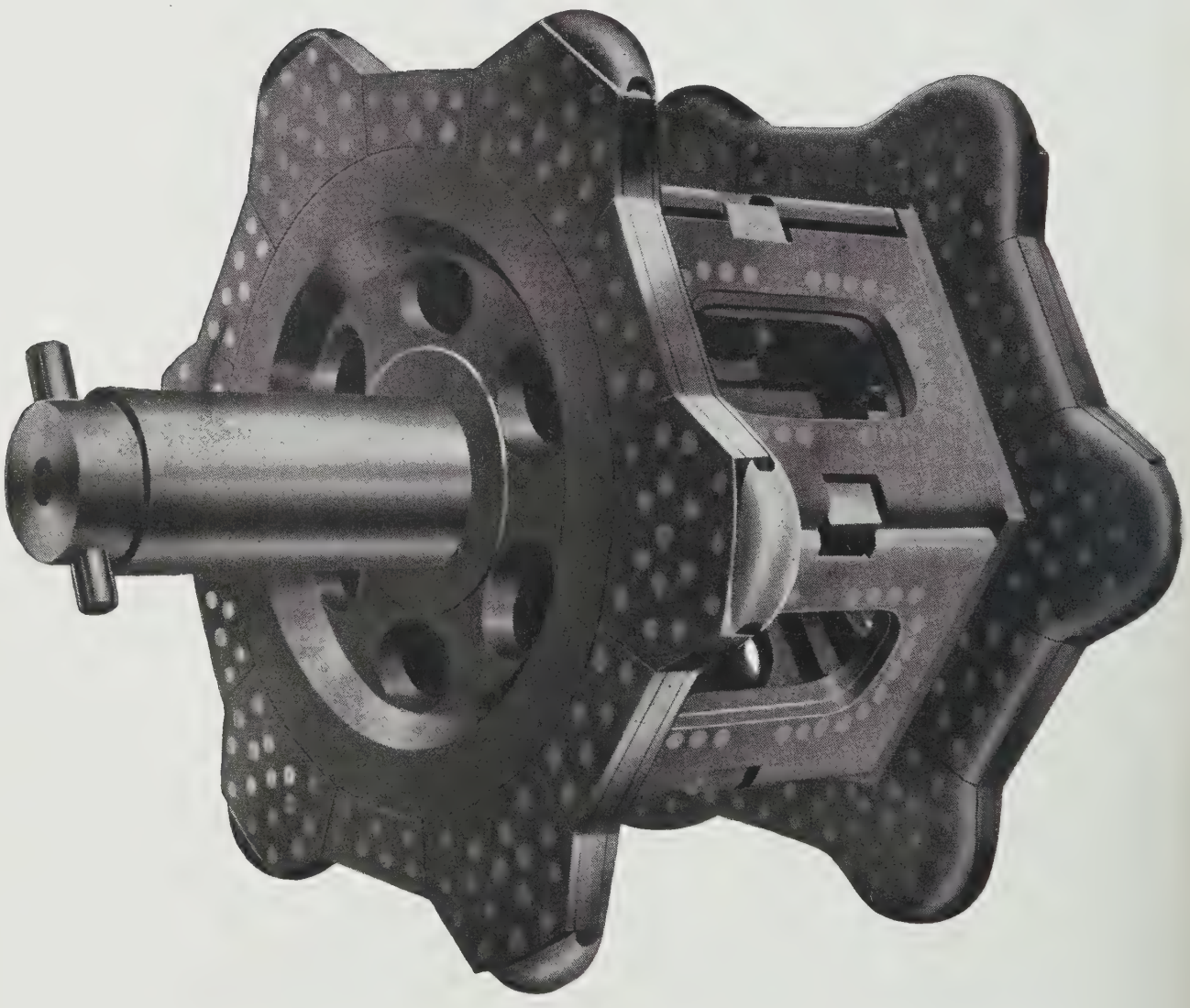
	Per cent
Ladder	0.2
Bucket line	5.3
Tumblers	11.3
Screens	17.8
Spuds	0.2
Stacker	4.0
Sluice pump	0.7
Sand pump	0.0
Winches	1.2
Lines	3.2
Motors	1.2
Power	7.8
Stepping ahead	23.6
Moving over	5.2
Clean-ups	12.4
Other causes	5.9
Thawing	0.0
Total	100.0
Running time	91.1%
Lost time	8.9%



Bow gauntree construction, on dredge of Canadian Klondike Mining Company, Limited

Crew only, exclusive of shops, stables, etc.

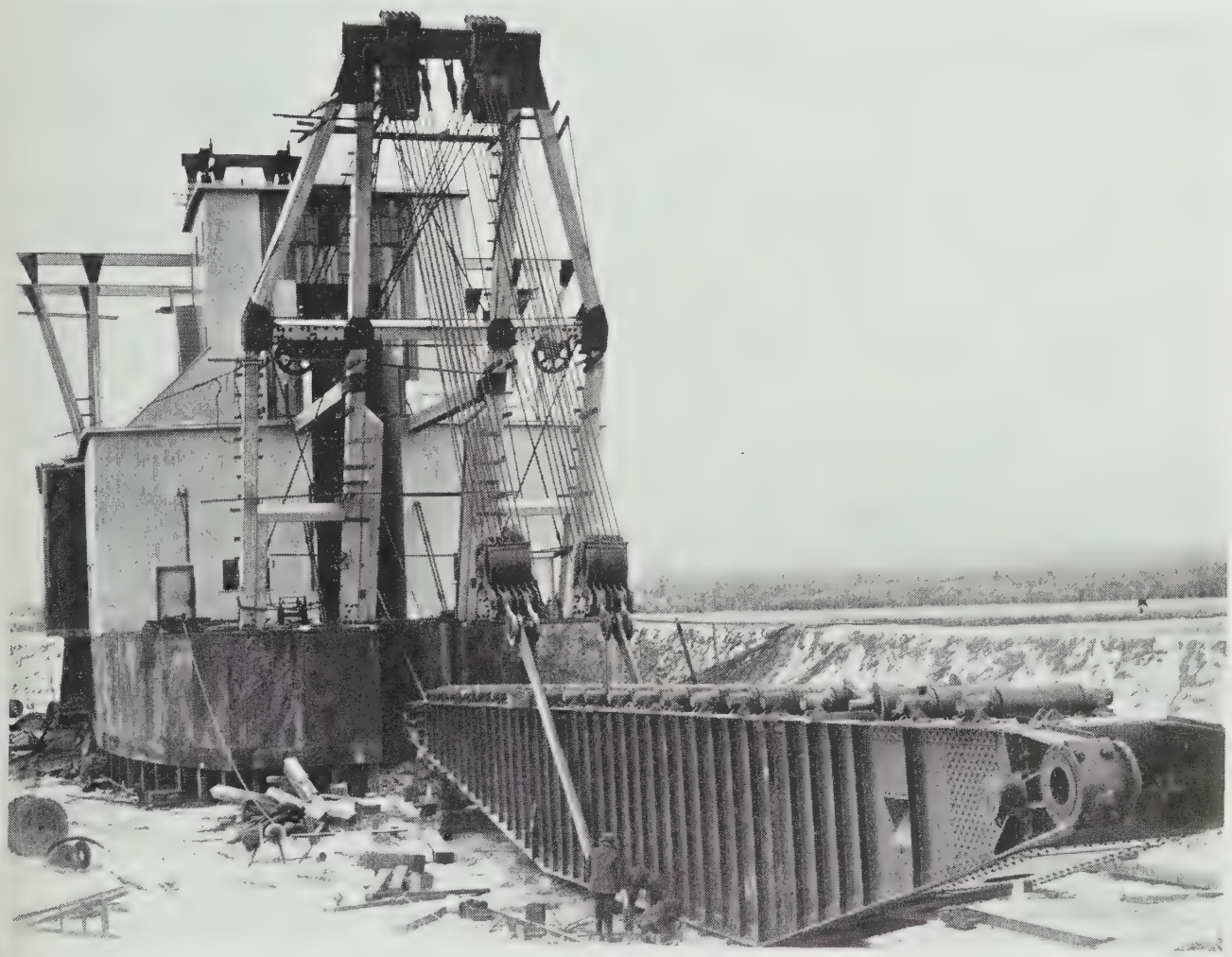
	Average cost per dredge per month
Dredge master	$ 276.56
Winchmen	599.49
Oilers	402.99
Labourers	1,072.85
Cleanup men and panners	173.19
General	39.19
Labour on repair work aboard dredges	176.72
	$2,740.99



Lower tumbler, on dredge of Canadian Klondike Mining Company, Limited

DETAIL COST PER CUBIC YARD FOR ALL DREDGES—SEASON 1914

	Cents per yd.
Fixed salaries	.07
Labour	2.51
Fuel	.05
Shop expense (repairs)	.43
Material and supplies	1.86
Power	1.28
Total indirect	6.20
Preliminary	1.66
Bullion charges	1.67
General charges	2.44
Depreciation	1.67
Insurance	.13
Assay office	.15
Stables	.23
Company telephone lines	.03
Miscellaneous	.05
Development	.50
Dredge construction	.71
Total direct	9.24
Thawing	12.18
Total operating costs	27.62



Digging ladder with ladder rollers installed, on dredge of Canadian Klondike Mining Co., Limited

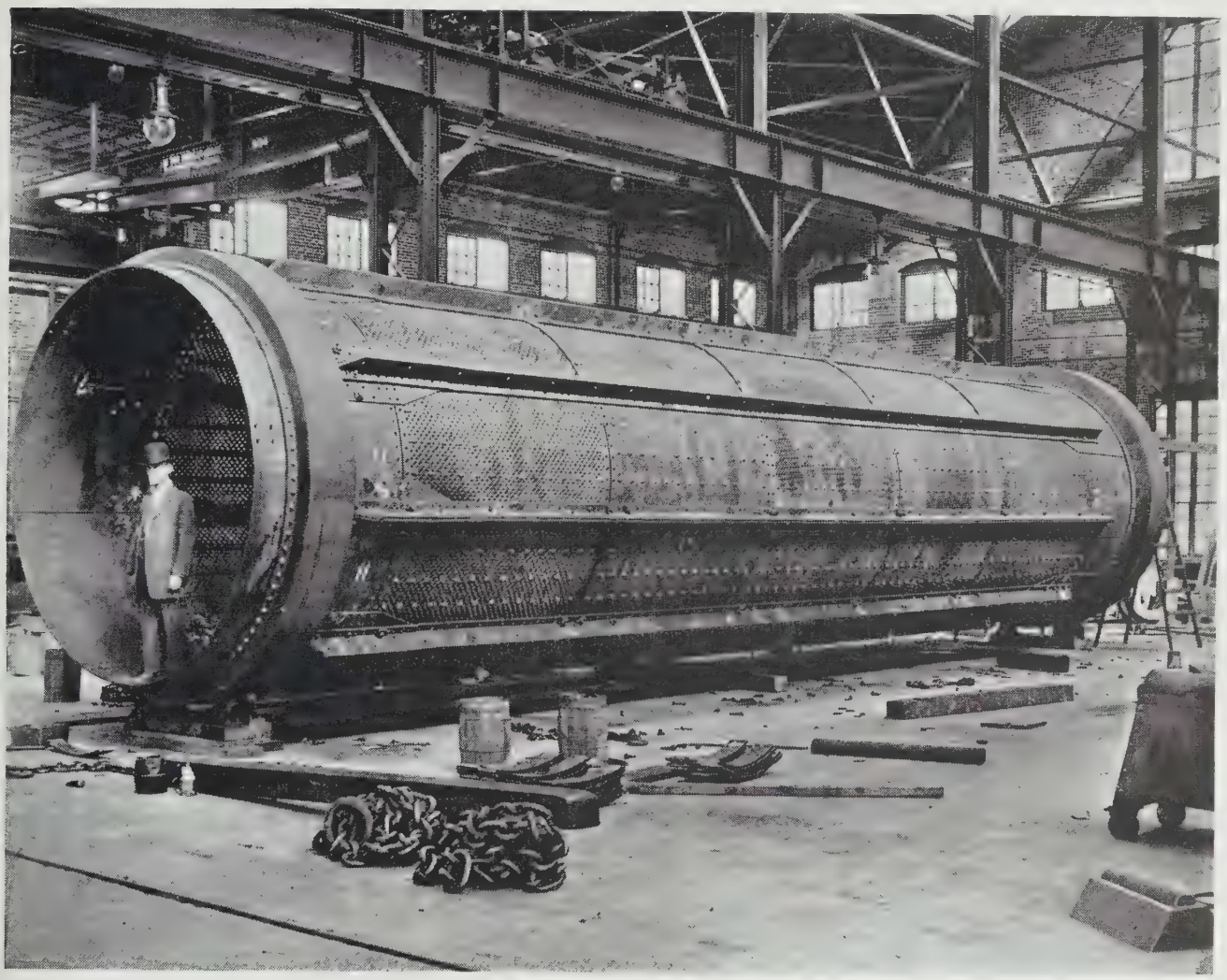
The following table contains in a concise form, complete information concerning the dredging operations of the Yukon Gold Company from 1910 to 1914 inclusive:—

YUKON GOLD COMPANY—DREDGE OPERATIONS

Year	Number of dredges	Commenced operations	Concluded operations	Average length of season	Time operated	Cu. yds. excavated	Sq. yds. thawed	% thawed	Total production	Yield per cu. yd., cents	Cost per cu. yd., cents	Working costs
1910	7	20th May	10th Nov.	147 days	84.7%	3,249,788	282,453	71.2%	$2,150,723.16	66.18	31.09	$1,010,304.89
1911	9	1st May	31st Oct.	172 days	81.5%	4,151,249	430,545	77.6%	2,671,845.19	64.35	35.43	1,470,674.76
1912	8	1st May	24th Oct.	172 days	86.15%	5,157,280	509,544	73.58%	3,346,026.79	64.88	30.64	1,580,289.82
1913	8	1st May	31st Oct.	184 days	79.6%	5,133,575	445,624	68.4%	3,343,667.37	65.13	29.53	1,515,872.20
1914	8	12th May	23rd Oct.	148 days	82.8%	4,800,781	412,796	73.0%	2,602,685.51	54.21	27.62	1,326,080.75

The annual report of the Yukon Gold Company for the year 1914, contains the following information on dredge operations for that year.

The eight Dawson dredges began operations on May 12th and ran until October 23rd. The period of operation was about twenty days shorter than that of the previous season, due largely to the discontinuance of the use of purchased power. The dredging season is now limited in length by the operation of the company's hydro-electric power plant, which, due to climatic conditions



Trommel or washing screen on dredge of Canadian Klondike Mining Company, Limited

has water available only from the 10th of May to the 20th of October, approximately.

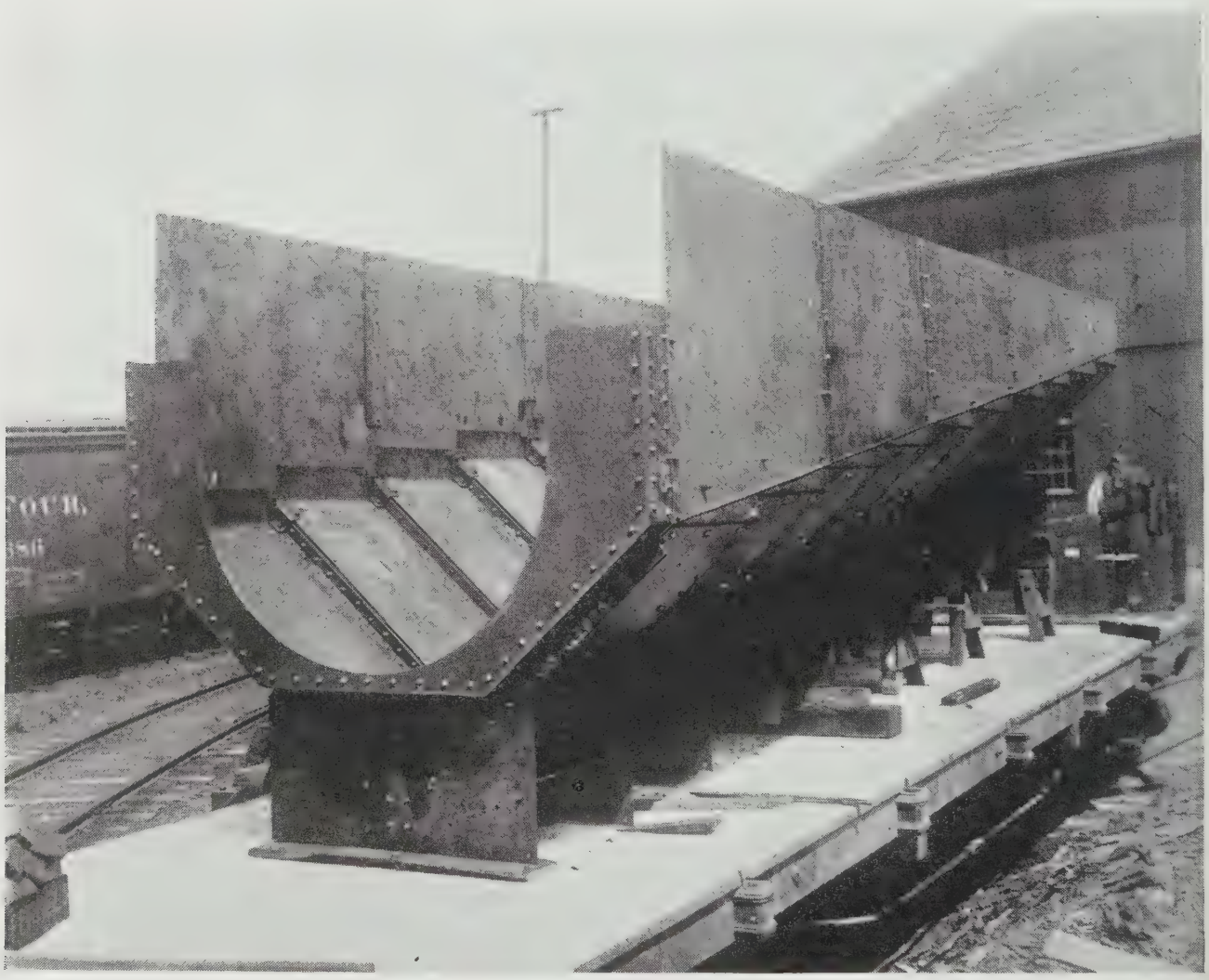
The average length of the dredging season was 164 days, during which the dredges operated 87.2% of the possible time. The dredges mined 4,800,781 cubic yards, which produced $2,602,685, or an average of 54.21 cents per cubic yard. The average cost, including depreciation, was 27.62 cents per cubic yard, which is lower than last season by about 2 cents per cubic yard. The results, compared with last season, show a decrease in yardage, due to the shorter period of operation, previously referred to. The decrease in production followed upon

the decrease in yardage; also there was a reduction in value of 10.92 cents per cubic yard. Less high grade ground was dredged than the season before and the depth of trailings handled was greater, which reduced the value per cubic yard. The total cost was less than the previous season by $189,792, and the royalties paid to owners were less by $111,107.

"While the total yardage was less than in 1913, the average duty of the dredges was higher in that they handled a higher yardage for the operating time. This was due in a large measure to the excellent power service maintained by the company's plant. The thawing cost was reduced 1.39 cents per cubic yard and was lower than for any other season since operations commenced. During the season a total of 421,835 square yards, or 68.6% of the ground handled was frozen and had to be thawed by steam."

"The total production of the Yukon Gold Company's dredges since the beginning of operations in 1907 is *$16,175,192, and for the hydraulic, including mechanical elevators, *$3,184,429."

* This is the first time these figures have been published. They do not, of course, include the production of the Yukon Gold Company's dredges and hydraulic plants for 1915.



Screen housing or distributing trough showing method of distributing water and materials to the sluice tables, on dredge of Canadian Klondike Mining Company, Limited

The general information and particulars of working costs, as shown by the following Tables I. to V. inclusive, were furnished by dredging companies operating in the Klondike district:—

TABLE I.

STATEMENT SHOWING RESULT OF OPERATIONS OF A DREDGE DURING YEAR IN COMMISSION. FROM MAY 12TH, 1914, TO OCTOBER 18TH, 1914

Make of dredge, Bucyrus.
Type of dredge (1), 7½ cu. ft. bucket.
Revolving screen.
Capacity of dredge, per day (actual), 5,042 cu. yds.
Power, 300 K.W.
Horsepower consumed, 300 H.P.

Date of completion, September, 1910.
Character of gravel, angular, medium, compact clay, near bed-rock.
Average depth of muck, 10′.
Average depth of gravel, 8′ —18′.
Nature of bed-rock, schist and igneous rock.
Character of bed-rock, slabs, blocky, soft in places.
Average daily run, 22 hours.

Month ending	Operations			Running expenses				Repairs	General expense	* Total expense	Cost per cu. yd., cents
	Running time, hrs.	min.	Ground worked, cu. yds.	Labour	Material	Power	Fuel	Labour and material, shop expense			
April											
May	370	30	96,935	$2,025.99	$1,417.91	$1,153.95		$984.18	$9,403.93	$14,985.96	.1546
June	637	45	149,730	2,545.65	2,969.70	1,472.47	$13.69	857.84	13,778.83	21,638.18	.1445
July	667	35	205,912	2,881.77	3,780.43	1,545.47	5.72	417.04	11,991.84	20,622.29	.1001
August	639	20	134,239	2,854.02	2,190.45	1,552.89	39.77	373.32	11,729.32	18,739.77	.1518
September	571	10	140,860	3,239.63	1,430.35	1,472.57	228.63	416.49	11,072.86	17,860.53	.1268
October	302	50	73,991	2,202.91	154.60	1,624.92	207.96	143.92	7,833.38	12,167.69	.1645
November											
December											
Total	3189	10	801,667	$15,749.97	$11,943.44	$8,822.27	$495.77	$3,192.79	$65,810.16	$106,014.42	

* Thawing cost not included.

TABLE II.

STATEMENT SHOWING RESULT OF OPERATIONS OF A DREDGE FROM MAY 17, 1913, TO DECEMBER 21, 1913

Make of dredge, Marion Steam Shovel Co., Marion, Ohio.
Type of dredge, 17 ft. bucket.
Revolving screen.
Power, electric.
Power consumed, 2,331,800 K.W. hrs.

Date of completion, May, 1913.
Character of gravel, medium.
Average depth of muck, 5 feet.
Average depth of gravel, 21.5 feet.
Nature of bed-rock, quartzites and schists.
Character of, hard and blocky.
Average daily run, 20 hrs. 42 min.

Month ending	Operation		Running expenses				Repairs		General expense	Total expense	Cost per cu. yd., cents
	Running time, hrs. min.	Ground worked, cu. yds.	Labour	Material	Power	Water	Labour	Material			
April											
May	319 53	99,260	$1,720.26	$492.64	$ 766.00		$ 152.46		$250.14	$3,381.50	3.40
June	642 43	229,985	3,071.40	213.45	1,725.00		447.05	$ 334.00	812.70	6,603.60	2.87
July	636 33	304,625	3,060.63	146.86	1,720.00		2,326.65	902.93	2,481.65	10,638.72	3.49
August	627 15	305,680	2,885.71	382.18	1,705.00		2,382.08	3,373.36	691.18	11,419.51	3.73
September	544 59	271,055	2,810.49	122.01	1,483.50		2,594.91	283.31	498.10	7,792.32	2.87
October	660 43	254,495	3,242.95	249.45	1,630.00		1,014.63	1,387.71	1,058.41	8,583.15	3.37
November	652 49	228,145	3,747.97	169.92	1,638.00		931.84	951.48	2,700.78	10,139.99	4.44
December	421 25	118,200	3,127.98	130.17	1,044.50		674.73	6,433.70	1,666.95	13,078.03	11.06
Total	4506 20	1,811,445	$23,667.39	$1,906.68	$11,712.00		$10,524.35	$13,666.49	$10,159.91	$71,636.82	3.954
Average, month..	632 59	254,452									

TABLE III.

STATEMENT SHOWING RESULT OF OPERATIONS OF A DREDGE FROM JUNE 6, 1913, TO NOVEMBER 9, 1913

Make of dredge, Marion Steam Shovel Company, Marion, Ohio.
Type of dredge, 7½ ft. bucket.
Revolving screen.
Power, electric.
Power consumed, 461,590 K.W. hrs.

Date of completion, August, 1905. Dismantled and rebuilt, 1913.
Character of gravel, disintegrated schist.
Average depth of muck, 15 ft.
Average depth of gravel, 6 ft.
Nature of bed-rock, mica schist.
Character of, hard and slabby.
Average daily run, 20 hrs. 22 min.

Month ending	Operation		Running expenses				Repairs		General expense	Total expense	Cost per cu. yd., cents
	Running time, hrs. min.	Ground worked, cu. yds.	Labour	Material	Power	Water	Labour	Material			
April											
May											
June	528 37	83,845	$2,238.10	$174.59	$356.50		$1,205.06	$3,910.23	$819.20	$8,703.68	10.38
July	689 00	69,135	3,580.12	38.99	441.00		2,570.88	1,752.86	132.58	8,516.43	12.32
August	692 30	72,925	2,776.65	51.55	477.00		1,274.81	408.41	55.70	5,044.12	6.91
September	489 45	57,585	1,959.47		387.00		1,094.46	875.44	743.40	5,059.77	8.78
October	636 25	61,330	2,567.79	46.98	514.50		1,016.24	353.79	485.56	4,984.86	8.12
November	126 10	8,325	808.77	51.75	111.50		506.37	189.64	250.28	1,918.31	23.04
December											
Total	3162 27	353,130	$13,930.90	$363.86	$2,287.50		$7,667.82	$7,490.37	$2,486.72	$34,227.17	9.69
Average, month..	623 16	69,595									

TABLE IV.

Statement Showing Result of Operations of a Dredge from May 9, 1913, to December 12, 1913

Make of dredge, Marion Steam Shovel Company, Marion, Ohio.
Type of dredge, 17 ft. bucket.
Revolving screen.
Power, electric.
Power consumed, 2,887,600 K.W. hrs.

Date of completion, May, 1913.
Character of gravel, medium.
Average depth of muck, 3 feet.
Average depth of gravel, 23.6 feet.
Nature of bed-rock, quartzites and schists.
Character of, medium hard and fractured with occasional reefs of hard quartzite.

Month ending	Operation		Running expenses				Repairs		General expense	Total expense	Cost per cu. yd., cents
	Running time, hrs. min.	Ground worked, cu. yds.	Labour	Material	Power	Water	Labour	Material			
April											
May	452 13	180,910	$3,132.63	$215.68	$1,157.00				$320.71	$4,826.02	2.66
June	683 50	350,600	3,949.00	165.67	2,207.00		$101.98	$191.00	267.55	6,882.20	1.96
July	699 40	350,390	4,033.72	45.75	2,307.50		54.21	28.89	179.35	6,649.42	1.89
August	701 00	349,660	2,306.07	333.83	2,248.00		51.58	249.77	285.66	5,474.91	1.56
September	668 20	231,995	3,369.96	307.95	2,105.00		157.47	348.47	260.99	6,549.84	2.82
October	592 35	189,775	3,214.56	124.65	1,785.00		219.92	615.93	412.82	6,372.88	3.36
November	624 35	174,720	3,355.75	175.99	1,943.50		400.62	47.42	2,666.69	8,589.96	4.41
December	248 20	28,800	1,897.41	73.29	759.00			9.70	675.70	3,415.10	11.85
Total	4670 33	1,856,850	$25,259.10	$1,442.81	$14,512.00		$985.77	$1,491.18	$5,069.47	$48,760.33	2.625
Average, month..	663 54	263,945									

TABLE V.

STATEMENT SHOWING RESULT OF OPERATIONS OF A DREDGE FROM MARCH 30, 1913, TO DECEMBER 25, 1913

Make of dredge, Marion Steam Shovel Company, Marion, Ohio.
Type of dredge, 17 ft. bucket.
Revolving screen.
Power, electric.
Power consumed, 2,457,260 K.W. hrs.

Date of completion, November, 1910.
Character of gravel, medium.
Average depth of muck, 3 feet.
Average depth of gravel, 27.2 feet.
Nature of bed-rock, quartzites and schists.
Character of, blocky, with occasional reefs of hard quartzite.
Average daily run, 21 hrs. 17 min.

Month ending	Operation		Running expenses				Repairs		General expense	Total expense	Cost per cu. yd., cents
	Running time, hrs. min.	Ground worked, cu. yds.	Labour	Material	Power	Water	Labour	Material			
April	663 55	156,605	$3,167.37	$68.98	$1,166.00		$ 963.04	$1,762.22	$1,377.22	$8,504.83	5.43
May	697 10	250,970	3,465.94	20.19	1,244.50		1,077.64	44.00	1,743.68	7,595.95	3.03
June	686 16	332,455	3,067.91	16.50	1,295.00		1,006.22	1,154.97	302.64	6,843.24	2.06
July	682 16	278,695	3,168.44	125.83	1,560.00		1,539.95	1,781.44	252.64	8,428.30	3.02
August	679 36	300,060	2,966.19	129.82	1,479.50		1,121.98	121.50	279.26	6,098.25	2.03
September	504 30	218,570	2,256.63	1,233.07	1,089.50		5,867.21	12,108.52	710.83	23,265.76	10.64
October	667 45	345,465	2,824.59	117.14	1,540.25		1,406.63	601.17	1,468.53	7,958.31	2.30
November	628 45	271,670	3,129.49	152.09	1,508.50		1,235.48	1,223.20	2,018.43	9,267.19	3.41
December	535 08	187,420	3,530.08	106.98	1,291.25		518.42	910.39	2,057.66	8,414.78	4.49
Total	5745 21	2,341,910	$27,576.64	$1,970.60	$12,174.50		$14,736.57	$19,707.41	$10,210.89	$86,376.61	3.67
Average, month..	650 13	265,062									

Prospecting Dredging Ground

Experience and sound judgment are essential in the selection of property for dredging operations, and these qualities are particularly necessary in the details of prospecting for selection. To determine the character and value of gravel and of bed rock it is necessary to sink either shafts or drill holes.

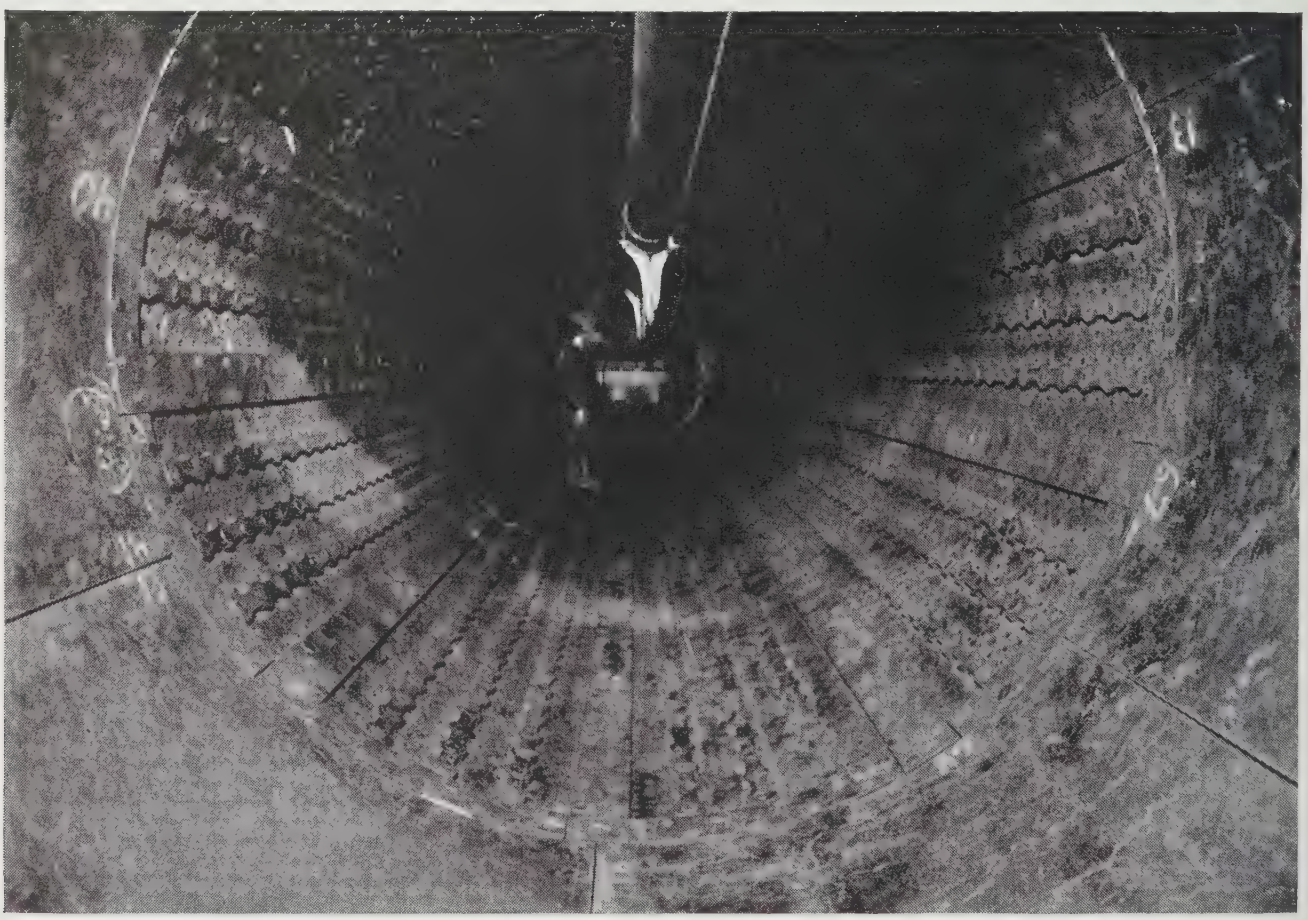
The beds of almost all the rivers* in the Yukon are unfrozen, and when dredging is confined to the bars and beds of rivers the most essential questions to be determined before the installation of the dredge are:—

1. The quantity of gold-bearing gravels in the property.
2. The distribution and value of the gold contents.
3. The depth and character of gold to be worked.
4. The cost of labour, transportation and supplies.
5. The cost of power, operating expenses and maintenance.

Dredging in frozen ground necessitates a further consideration of:—

1. The quantity, nature and cost of removing overburden.
2. The cost of thawing gravels.
3. The cost of installing a thawing plant.
4. The cost of fuel, operating expenses and maintenance.

* The Dredging Regulations define a river as " a stream of water the bed of which is of an average width of one hundred and fifty feet throughout the portion thereof sought to be leased."

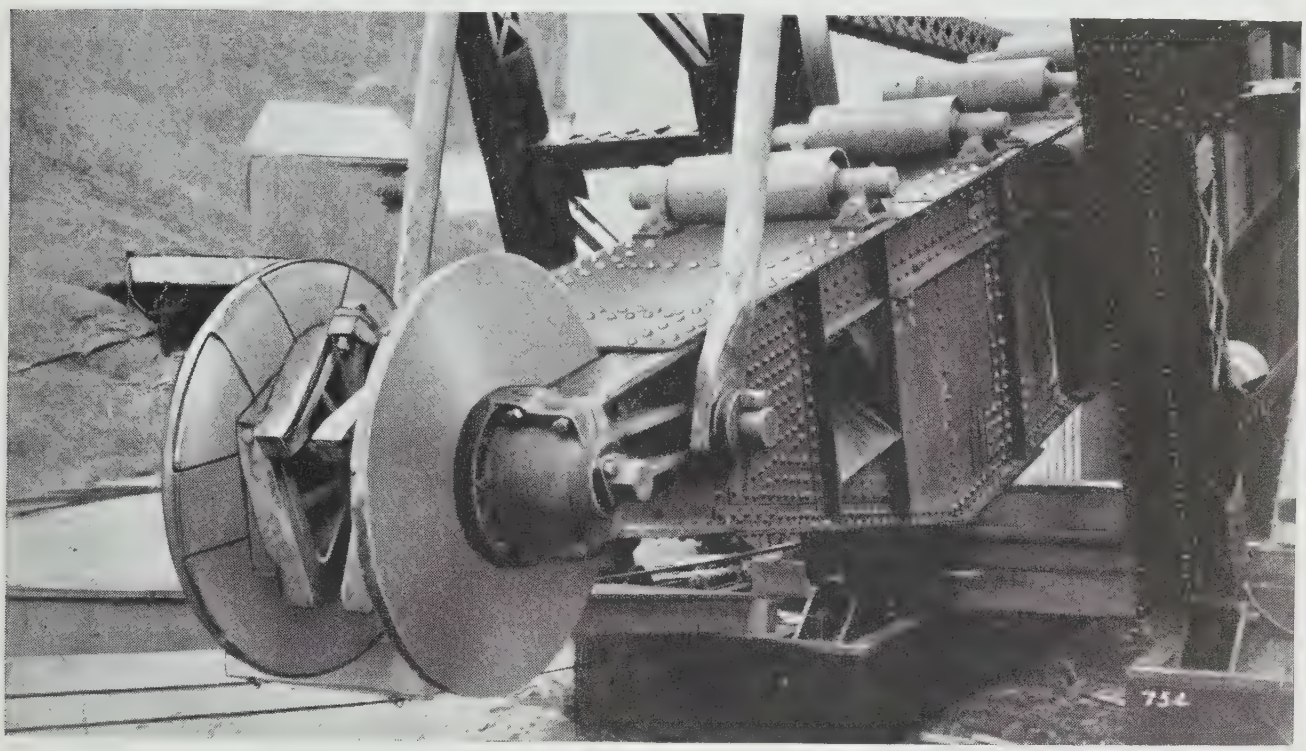


Interior of screen of Canadian No. 3

The usual mode of determining the values contained in the gravels in the Klondike district is by the operation of ordinary Keystone No. 3 traction machine. This drill is operated by steam power and the diameter of the hole bored is six or seven inches.

The drill crew consists of four men; the driller, a helper for the driller, panner and fireman. This has been found to be the fastest and most efficient crew for prospecting work.

The duties of the panner are to pan and rock all pumpings, and to keep a log showing depths at which pannings were taken, the number of colors in each pan and the character of the formation drilled.



Yukon No. 9. Lower tumbler with bucket line of steel Bucyrus, 7 foot dredge

No difficulty is encountered in drilling frozen ground as the ground is thawed by means of a steam point being driven to bedrock before drilling is started. Careful tests have been made in frozen ground by drilling two holes close together, drilling one frozen and the other thawed by steam. These tests show that considerable time is saved in thawing before drilling with practically no difference in the results.

Methods of testing ground vary greatly with the character of the property under examination. In drilling a narrow creek valley which has been worked more or less by drifting, lines of holes are put across the valley at intervals of 200′ to 500′. The holes are spaced from 25′ to 100′ apart on the cross-cutting lines, depending on whether the ground is "spotted" or not, and also on the extent of worked areas.

In estimating the gold content the worked out ground is given a value per cubic yard, the value depending upon the drill holes and the local conditions.

The value of the virgin ground is figured from the results shown from the gold recovered by the drill. Values estimated from drill prospecting are close to the recovery, where the drill holes are properly interpreted, but in worked or "spotted" ground averages, in the ordinary sense, cannot be used.

The operation of the Keystone drill consists of driving the casing, drilling and pulverizing the core, pumping out the core and panning. The casing is six inches in inside diameter with a cutting shoe on the bottom of 7″ diameter. Casing is driven until friction makes further driving difficult, then the core is drilled out. The bit used in drilling has a 5½″ cutting edge and is screwed on to a stem, weighing about 900 lbs. This weight is sufficient to cut and break up the core so that it can be pumped.

The churning action of the bit keeps the finely broken up core in suspension and prevents the sand from settling to the bottom and clogging the bit. The casing is always kept ahead of the bit in order to avoid drawing in gold from adjacent gravel when pumping out the core.

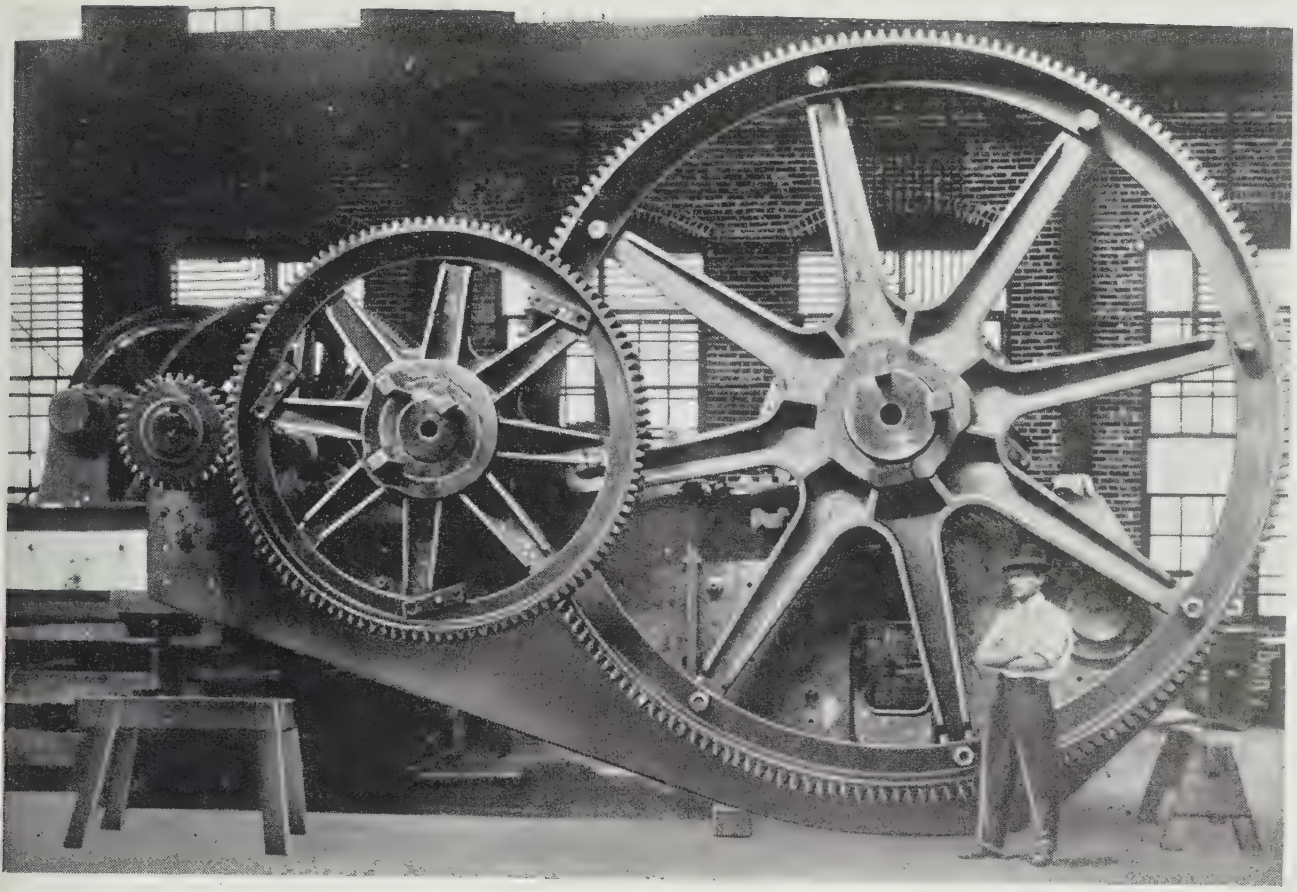
The following table shows the method of estimating results and the comparison as between the results of prospecting and actual values recovered by the dredge:—

Canadian No. 2 Klondike valley near Bear creek	Estimated value from drill (per cu. yd.)	Recovered by dredges (per cu. yd.)	Percentage Recovery
Week ending May 6, 1912.....	20.2 cts. (mean of 2 holes).....	14.1 cts.	70%
Week ending May 13, 1912.....	19.0 cts. (mean of 3 holes).....	16.0 cts.	84%
Week ending May 20, 1912.....	13.2 cts. (mean of 3 holes).....	18.3 cts.	139%
Week ending May 27, 1912.....	30.4 cts. (mean of 2 holes).....	30.8 cts.	101%
Week ending June 3, 1912.....	24.5 cts. (mean of 2 holes).....	16.4 cts.	67%
Week ending June 10, 1912.....	11.0 cts. (mean of 2 holes).....	13.2 cts.	120%
Week ending June 17, 1912.....	16.0 cts. (one hole only).....	18.5 cts.	116%
Week ending July 1, 1912.....	34.0 cts. (one hole only).....	21.5 cts.	63%
	8)168.3		
	21.04 cts. Mean 16 holes	8)148.8	
		18.60 cts.	88.4%

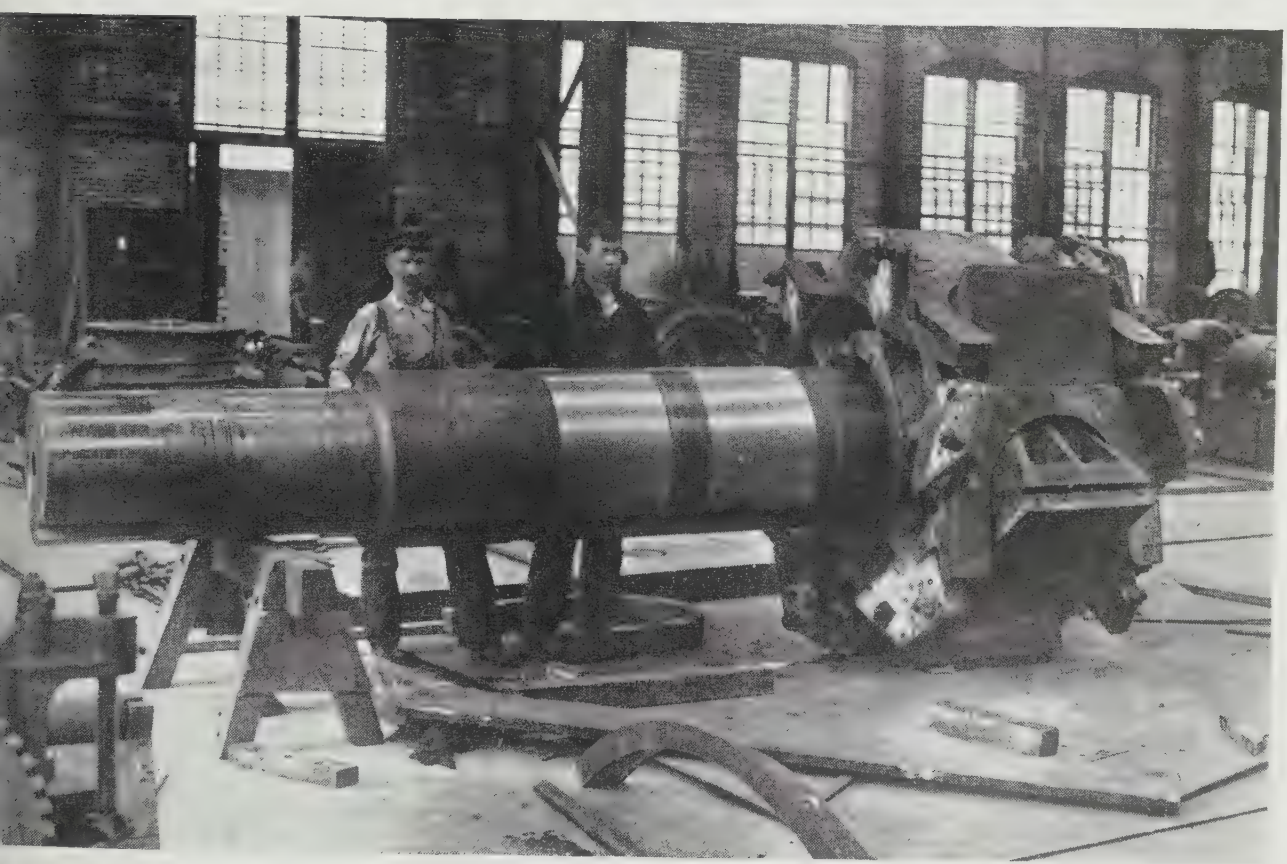
NOTE.—The above sixteen holes were chosen because the drilling was done in one hundred foot by two hundred foot blocks and the washing and estimating most carefully done.

The following costs were also furnished concerning drilling on Bunker hill:—

Labour	$71.66	$56.56	$80.44	$33.16
Board	26.40	21.60	30.00	12.00
Wood	30.00	25.00	40.00	20.00
Team	25.50	19.50	15.00	21.00
Supplies	23.47	11.02	15.77	6.46
	75 ft.	74.2 ft.	82.0 ft.	53.5 ft.
	$2.36 per ft.	$1.80 per ft.	$2.21 per ft.	$1.73 per ft.



Main drive set up, on dredge of Canadian Klondike Mining Company, Limited



Upper tumbler with shaft, showing tumbler about to be pressed on. Canadian Klondike Mining Company, Limited

Sluice tables on dredge of Canadian Klondike Mining Company, Limited

Stern of dredge, showing tailing stacker on dredge, of Canadian Klondike Mining Company, Limited

CHAPTER VI.

HYDRAULICKING

THERE are numerous hydraulic plants on the various creeks in the Klondike district, and the hydraulic operations of the Yukon Gold Company, taken as a whole, comprise one of the largest undertakings of this kind in the world. In the operations of this company over three million cubic yards are handled each season of five months.

The following particulars, which were obtained from the Yukon Gold Company, show the location and character of the various properties which are being worked by hydraulic methods, the water supply appurtenant to these properties and the various hydraulic plants of this company in the Yukon:—

Paradise Hill

Location.—This hill is located on the left limit of Hunker creek between Hester creek and Eighty Pup and is approximately one and one-half miles long with an average channel width of between six and seven hundred feet and varies in depth from a few feet on the Hunker creek rim to ninety feet at the extreme rear—about one-third of the ninety feet being "muck" or frozen decayed vegetation.

The course of this ancient channel is from south to north (generally speaking) paralleling the present Hunker creek valley. The elevation of the bedrock of this channel is approximately two hundred feet higher than the present level of the Hunker creek valley, thereby furnishing the necessary tailing depository for the hydraulic operations.

Deposit.—The deposit is a part of the Hunker creek "White Channel" so called, as the gravels are either white or light grey in color. This is due to the preponderance of quartz boulders and quartz sand in the deposit.

Water Supply.—The water for the hydraulic operations at this mine is furnished by two ditch lines; one, four miles long, from Hester creek, and the other, six miles long, from Independence gulch. The capacity of each of these ditches is 200 M.I.

As these ditches deliver the requisite quantity of water for only a short period of time in the spring, it was found necessary to construct an impounding reservoir so as to conserve the water until such time as the supply would justify starting washing operations.

Hydraulic Plant.—Owing to the limited and uncertain water supply at this mine it was deemed advisable to install only such plant as would handle the supply of water when the ditches were operating to capacity.

The main pipe line from the penstock into the mine, a distance of about 400 feet, is 15″ in diameter, the sub-lines are 10″ in diameter, and supply 3, No. 1 hydraulic giants. Two of these are used at a time, and the washing is assisted by an "over-bank" head of about 100 inches. The total head in the present pit is about 80 feet.

The sluice line is about 500 feet long, 30″ wide and 24″ deep and is paved partly with wooden blocks (10″ x 10″ x 10″) and partly with longitudinalmanganese steel riffles.

Hydraulic mining on property of The Yukon Gold Company, Lovett gulch

The sluice line has a gradient of 10½ inches to 12 feet.

Lovett Gulch and Trail Gulch

Location.—The channel of Bonanza creek opposite these two gulches really constitutes one mine and is being worked as such. The white (or pay) channel is located on the right limit of this part of the creek, and extends from Trail gulch through to Jackson gulch on the Klondike river slope, a distance of one and one-half miles. It is much greater in volume than higher up the creek,

attaining a maximum width of two thousand feet and a maximum depth of nearly four hundred feet.

Deposit.—The deposit at this point, while retaining the characteristic color, contains a much greater percentage of quartz sand, the cobble-sericite and quartz being much smaller and better rounded. To these differences is due the high duty of the water used.

Hydraulic mining on property of The Yukon Gold Company, Lovett gulch

Water Supply.—The water used in these operations is conveyed from the Twelve Mile river water shed through a ditch system 60 miles long to a point on the Klondike flat where the water is diverted for use at these mines. The system consists of ditch, flume and pipe alternately, and delivers a maximum of 5500 M.I. of water at this point when running to capacity. The system extends up Bonanza creek for a distance of 10 miles, but its maximum carrying capacity beyond Trail gulch is 3,000 M.I.

Hydraulic Plant.—The main distributing pipe line for this mine, from the penstock to a point on the ridge between the two gulches, is 2500 feet in length, contains pipe of diameters varying from 30″ at the intake to 22″ at the lower end. The sub-distributing lines consist of two lines, one 16″ in diameter and the other

14″ in diameter, into Lovett gulch, and one line into Trail gulch 16″ in diameter. In addition to these there is a line 14″ in diameter, extending down the ridge between the two gulches which furnishes bank head water for each place as required.

All of these lines are constructed of spiral riveted sheet steel pipe with bolted joint connections, the thickness of the steel varying with the pressures and diameters of pipes. From the sub-distributing lines to the giants 12″ pipe, both

Hydraulicking muck at 78 below lower Discovery, Dominion creek, showing strata of ice in frozen muck, property of North-West Corporation, Limited

plain and spiral riveted, is used. There are four of these lines at each mine, each fitted with a 12″ gate, which supply the water to four No. 3 Joshua Hendy ball-bearing hydraulic giants. The pressure per sq. in. at the nozzles varies with the number of streams used and runs from 40 lbs. to 150 lbs. to the sq. in. The gravels disintegrate so readily that the greater pressures are only required at such times as the top gravels are being washed.

On the Lovett gulch side there are three independent sluice lines, two on the right limit and one on the left limit. These lines are each over 200 feet in length, 4 feet wide, 30 inches deep, and are paved with both longitudinal and cross-wise riffles made of manganese steel. The tail end of the sluice, where no values are recovered, is lined with high carbon steel plates which are cut 6 feet long and 47″ wide. These plates are ½″ in thickness.

On the Trail gulch side there are also three independent lines of sluice each of them over 200 feet in length and paved in the same manner as the lines on the Lovett side. They differ, however, in size, two of them being 3 feet wide, and the third 40″ wide. All are of same depth, to-wit: two feet.

The gradient of all sluice lines at both Lovett and Trail gulches is 8″ to each 12 feet.

On the hydraulic giants 4″, 5″ and 6″ nozzles are used, different combinations being made according to the supply of water and the material to be sluiced, about 2,400 M.I. of water being used at this point when available.

Hydraulicking muck at No. 35 below lower Discovery, Dominion creek, property of North-West Corporation, Limited

Bunker Hill

Location.—The gravel deposit at this point is on the right limit of Bonanza creek, opposite claims Nos. 17, 18, 19 and 20 above Discovery, or downstream from Gauvin gulch, a tributary of Bonanza creek on its right limit, and having its confluence on the lower end of claim No. 21 above Discovery.

Character of Deposit.—The depth of the deposit varies from 20 feet on the rim to 75 feet at the deepest section. The gravel at this mine is much harder to wash and the duty of the water is much less than at the other mines on Bonanza creek. This is due to the greater percentage of medium sized rocks which are more angular than those found in the deposit lower down the creek.

Water Supply.—All of the water used in the operations at this mine comes from Bonanza creek and its tributaries on the right limit, between the point of diversion of the ditches and the mine. There are two ditches used in carrying water, one with an intake at claim No. 51 above Discovery, and the other with an intake at claim No. 57 above Discovery. A dam 70 feet high was constructed across Bonanza creek just above the intake of the ditch, having an intake at claim No. 57. This is used to conserve the freshet waters and admit of their being used later on in the season as required. The ditches are approximately six miles long each, and were constructed to carry 500 M.I. (each.)

Hydraulic operations on property of North-West Corporation, Limited, Dominion creek

Hydraulic Plant.—The main pipe line, leading from the penstock into the mine, a distance of 500 feet, is 15″ in diameter and is plain-riveted slip joint pipe made of No. 16 B.G. sheet steel.

The distributing lines, leading from the main line to the giants, are of similar pipe and 10″ in diameter. There are four of these lines, with a gate in each line, supplying water to four Joshua Hendy No. 2 ball bearing giants. The pressure at the nozzles is only 30 lbs. to the square inch, equal to the height of the bank—75 feet.

The sluice line is 200 feet long; is 3 feet wide and 2 feet deep; has a gradient of 8″ to every 12 feet, and is paved with angle iron riffles, set crosswise, and wooden blocks (11″ x 11″ x 10″.)

Clear British Columbia fir, 2″ thick, is used for the sluice bottoms, and the remainder of the lumber is obtained from the local mills.

Adams Hill, American Gulch, American Hill, Cheechaco Hill, Gold Hill, King Soloman Hill, Magnet Gulch, Monte Cristo Gulch

Location.—The "White Channel" on Bonanza creek at these points presents practically an unbroken face of gravel four miles long, extending from the confluence of Bonanza and Eldorado creeks to Boulder creek. The deposit for this entire distance is on the left limit of the creek and parallels the course of the present Bonanza creek valley. It is virtually one mine and the subcaptions above refer to the points at which hydraulic operations have been started.

Yukon Gold Company
The 5 foot by 7 foot flume between discharge of syphon crossing Little Twelvemile valley and intake penstock of power plant pipe

Deposit.—The deposit shows no stratification, the gravels rest on a decomposed schist bedrock and the major values are contained in the lower 20 feet of gravel and the first three feet of bedrock. The channel for this section has an elevation 195 feet above the present Bonanza creek valley, has widths varying from 500 feet to 1,000 feet—depending on whether or not any of the section has been eroded away and with depths varying from 10 to 20 feet on the rim to 150 feet in the deepest sections. The deposit is frozen for its entire depth and is not covered with "muck" as are the creek gravels. The gravel when thawed disintegrates readily and the greater percentage of the values is recovered in the first 50 feet of sluice. The gold also is easily amalgamated, thus differing somewhat from some of the gold obtained from the present creek beds.

Water Supply.—The major portion of the water used in washing gravel on this section of the channel comes from the watershed of the Twelve Mile river and is delivered by a ditch system having a length over all of 70 miles; 40 miles of this system being ditch and the remainder flume and pipe. The capacity of this system is 5,500 M.I. to the point where the supply for Lovett gulch mines is diverted; from this point up Bonanza the capacity is about 3,000 M.I.

Yukon Gold Company
Bradley creek flume. Along the line of the main ditch system. Capacity, 5,000 M.I.

The ditch system from Lovett up Bonanza follows the right limit to a point opposite Fox gulch where it is taken across Bonanza creek by means of an inverted syphon and thence up the left limit to Gold hill—the end of the ditch.

In distributing the water supply, the upper Bonanza ditch is kept running to capacity at all times.

Yukon Gold Company

Bonanza pipe crossing. The water supply for all the hydraulic mines on the left limit of Bonanza crosses Bonanza creek on claim 25 below Discovery. The pipe shown in this picture is spiral riveted, is 38 inches inside diameter, has a thickness of 9-32 of an inch, and is under a head of 500 feet or about 215 pounds per square inch. The trestle carrying this pipe is 520 feet long.

During the spring and late fall a limited quantity of water is supplied to some mines in this section from local ditches with source of supply in Adams and Boulder creeks.

Adams Hill, etc., Hydraulic Plant.—Owing to various reasons—such as quantity of gravel to be moved, different pressures of water, etc., etc.,— the equipment at the different points of attack vary considerably. For this reason each plant is described separately.

Adams Hill:—

Size of main distributing pipe line.....15″ in diameter; sub-lines 12″ and 10″ in diameter.
Size of giants.....Hendy No. 2.
Number of giants used.....3.
Pressure in lbs. per sq. in.....45.
Size of nozzles used.....3″ and 4″.
Length of sluice line.....150′; width 3′; depth 2′.
Gradient of sluice.....8″ to each 12 foot box length.

Sluice paved with longitudinal manganese steel riffles and wood blocks.

American Gulch and American Hill:—

These two hydraulic pits are worked in conjunction.

Main distributing pipe line.....30″ in diameter; sub-lines 14″ and 12″ in diameter.
Size of giants.....Hendy No. 3 and 5.
American gulch.....Two No. 3's.
American hill.....Two No. 5's and two No. 3's.
Pressure in lbs. per sq. in. (both).....85 lbs.
Size of nozzles used.....4″, 5″ and 6″.
Length of sluice lines.....200′.
Width of sluice lines.....52″.
Depth of sluice lines.....30″.
Gradient of sluice line.....8″ to each 12 foot box.

Sluices paved with manganese steel riffles placed longitudinally and crosswise.
High carbon steel plates used in tail sluice.

Plates.....½″ thick, 6′ long, and in width 1″ less than sluice.

Cheechaco Hill:—

Main distributing pipe lines.....Two in number, one 16″ in diameter, and other 15″; sub-lines 12″ in diameter.
Size of giants used.....Hendy No. 3.
No. of giants used (placed).....5.
Pressure in lbs. per sq. in.....55.
Size of nozzles used.....4″ and 5″.
Length of sluice line.....400′.
Width of sluice line.....4′.
Depth of sluice line.....30″.
Gradient of sluice line.....8″ to 12′.

Sluice lined with manganese steel riffles placed lengthwise and angle-iron riffles placed crosswise.

Gold Hill:—

Main distributing pipe line.....22″ in diameter, tapering to 14″ diameter at mine. Sub-lines 10″ diameter.
Size of giants used.....Hendy No. 2.
Number of giants used.....4.
Pressure in lbs. per sq. in.....45.
Size of nozzles used.....3″ and 4″.
Length of sluice line.....150′.
Width of sluice line.....3′.
Depth of sluice line.....2′.
Gradient of sluice line.....8″ to 12′.

Sluice lined with steel riffles placed lengthwise, and wood blocks 11″ x 11″ x 10″ thick.

King Solomon and Monte Cristo:—

These are worked in conjunction having same distributing pipe line.

Main distributing pipe line	16″ in diameter. Sub-lines 12″ in diameter.
Size of giants used	Hendy No. 3.
Number of giants used	King Solomon, 3. Monte Cristo, 4.
Pressure in lbs. per sq. in	85 and 90 lbs.
Size of nozzles used	4″ and 5″.
Length of sluice lines	over 200′.
Width of sluice lines	3′ and 40″.
Depth of sluice lines	2′.
Gradient of sluice lines	8″ to 12′.

Sluices lined with manganese steel riffles lengthwise and angle-iron riffles crosswise.

Magnet Gulch:—

Main distributing pipe line is	14″ in diameter and takes off from main American hill line. Sub-lines are 12″ in diameter.
Size of giants used	Hendy No. 3.
Number of giants used	2.
Pressure in lbs. per sq. in	85 lbs.
Size of nozzles used	5″ and 6″.
Length of sluice line	300′.
Width of sluice line	40″.
Depth of sluice line	30″.
Gradient of sluice line	8″ to 12′.

Sluice lined with manganese steel longitudinal riffles and angle-iron cross riffles.

All sub-distributing pipe lines are fitted with gates to facilitate the distribution of the water, as, owing to the frozen state of the gravel banks, changes are more frequent than in other climes.

British Columbia fir, clear of knots and two inches thick, is used for bottoms in all of the sluices. Lumber from local mills is used for remainder of the sluice construction. The price of local lumber is shown in appendix.

The pipe lines, giants, sluices, etc., may not be so large as used in the mines of other parts of the world, but they are specially chosen to fit the existing conditions, and have proven adaptable to the requirements.

Bonanza basin

The following statement shows in a concise form the magnitude and the results of the hydraulic operations of the Yukon Gold Company's Twelve Mile water system.

YUKON GOLD COMPANY—HYDRAULIC OPERATIONS

TWELVEMILE WATER SYSTEM

Year	Period of operation	Percentage of possible time	Water supply M.I.	Cu. yds. handled	Operation and maintenance ditch	Cost per cu. yd.	Duty of water	Gold production	Total cost
1910	.....	.....	371,206	1,656,020	$140,433.00	20.8	4.5	$226,025.93	$264,378.52
1911	.....	.....	482,580	2,125,750	135,710.00	15.5	5.4	298,007.22	251,213.39
1912	168 days	96.8	524,249	2,967,750	76,760.00	9.37	5.4	628,874.72	277,953.12
1913	150 days	93.28	406,135	2,875,952	73,054.00	9.7	6.6	247,557.06	278,917.11
1914	168 days	96.29	519,834	3,241,641	64,397.18	7.6	6.02	544,262.15	245,685.95

Drain for carrying off ground sluiced material, property of North-West Corporation, Limited, Dominion creek

The annual report of the Yukon Gold Company for the year 1914, contains the following information respecting hydraulic operations for that year:—

A total of 3,241,641 cubic yards of material were handled by the hydraulic process, which produced $544,262 at a cost of $245,686. The working cost was 7.6 cents per cubic yard, exclusive of depreciation of the main ditch, which is a decrease of 2.1 cents per cubic yard as compared with the previous season. The total water used amounted to 519,834 M.I. as compared with 406,135 M.I. in 1913, a gain of over 25%. The duty of the water was 6.02 cubic yards to the miner's inch.

The Twelve Mile water system was operated from May 8th to September 30th inclusive, a total of 146 days. The average daily delivery was 3,561 M.I. The ditch was operated for 96.4% of the possible time. Severe frosts early in September caused considerable difficulty in keeping the ditch open, otherwise the system gave excellent service.

Yukon Gold Company

Pure gold crossing. Pure gold is a tributary of Bonanza creek which comes into Bonanza at 67 below Discovery. This pipe is wood stave of 35 inches inside diameter and has a total length, from intake to discharge, of 1,626 feet. It is under a maximum head of 236 feet, or a little over 100 pounds per square inch.

Drain for carrying off ground sluiced material, property of North-West Corporation, Limited, Dominion creek

The annual report of the Yukon Gold Company for the year 1914, contains the following information respecting hydraulic operations for that year:—

A total of 3,241,641 cubic yards of material were handled by the hydraulic process, which produced $544,262 at a cost of $245,686. The working cost was 7.6 cents per cubic yard, exclusive of depreciation of the main ditch, which is a decrease of 2.1 cents per cubic yard as compared with the previous season. The total water used amounted to 519,834 M.I. as compared with 406,135 M.I. in 1913, a gain of over 25%. The duty of the water was 6.02 cubic yards to the miner's inch.

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Hydraulic Costs

The following costs cover the mining of 3,241,642 cubic yards with a total of 538,905 twenty-four-hour miner's inches, which give a duty of 6.02 cubic yards per M.I. The total area of bedrock cleaned was 126,057 square yards.

Costs	Per cu. yd.
Fixed salaries	.001
Labour	.023
Shop expenses (repairs)	.001
Supplies	.003
Preliminary expense (charges during closed season)	.006
Bullion charges (mint refining and government gold tax)	.005
General charges	.007
Depreciation on distributing pipe lines	.009
Stables	.001
Transportation (skilled labour)	.001
Main ditch operation—	
Water, including depreciation	.069
Total operating costs	.126

Yukon Gold Company

Little Twelvemile or power ditch. This system, composed of ditch and flume, has a capacity of 2,000 M.I. and was built to furnish the water supply for the power house

Hydraulic plants are also being operated on the Klondike hills and on Hunker and Dominion creeks by the following mine owners and companies:

Klondike Hills, left limit, above mouth of Bonanza creek

The Finlaison group comprises 11 hill claims on the left limit of Klondike above the mouth of Bonanza creek and, during the season of 1914, hydraulic operations were carried on upon Discovery bench. The water is diverted from Quigley gulch and six tributaries of the Klondike, between Quigley and Jackson gulches, and conveyed a distance of 3½ miles by a ditch having a capacity of 2,000 miners' inches, and applied under a pressure of 75 feet. The bank consists of about 50 feet of gravel. Water is available during the early spring freshets and rainy periods during the summer, and during the 1914 season 5,000 cubic yards of gravel were removed. The tailings are retained on hill ground.

Yukon Gold Company. Tailings Dam at mouth of Monte Cristo gulch, Bonanza creek

J. W. Park is the owner of 2 hill claims on the left limit of the Klondike river above the mouth of Bonanza creek and, during the season of 1914, was hydraulicking on hill No. 19, by means of water, diverted from Jackson gulch at a distance of 1½ miles, through a ditch having a capacity of 200 miners' inches and applied under a pressure of 100 feet. The bank consists of about 50 feet of gravel. Water is available at intervals from May 1st to October 1st, and during the season 4,000 cubic yards of gravel were removed. The tailings are retained on hill ground.

Hunker and Last Chance Hills

William Scouse *et al* are the owners of 21 hill claims on the left limit of Hunker creek, and during the season of 1914 were hydraulicking on hill claim No. 33. Water is diverted from Henry gulch at a distance of two miles, by means of a ditch having a capacity of 200 miners' inches, and applied under a pressure of 75 feet. The bank consists of about 30 feet of gravel. Water is available only during the spring freshets and rainy periods from May 1st to October 1st, and 6,800 cubic yards of gravel were removed. The tailings are retained on hill ground.

John Mahon *et al* are the owners of 75 claims on Hunker and Last Chance creeks, and during the season of 1914, were hydraulicking on hill claim No. 3 above the mouth of Last Chance creek. The water is diverted from Last Chance creek and conveyed a distance of 4 miles by a ditch having a capacity of 200 miners' inches and applied under a pressure of 100 feet. The bank consists of gravel 25 feet. Water is available from May 1st to October 1st, and during the season 35,000 cubic yards of gravel were removed. The tailings were dumped on creek No. 2, upper half, above the mouth of Last Chance owned by the operators.

Messrs. Wilson and Townshend are the owners of 6 hill claims on the left limit above the mouth of Last Chance creek and during the season of 1914 were hydraulicking on Morris bench, 2nd tier, lower half, left limit of No. 7 above the mouth of Last Chance creek. The water is diverted from Henry gulch and conveyed a distance of two miles by a ditch having a capacity of 200 miners' inches and

Dam at Jensen creek, where water is diverted into the system of ditches, property of North-West Corporation, Limited

applied under a pressure of 75 feet. The bank consists of 50 feet of gravel. Water is only available during the early spring freshets and heavy rains at intervals during the season, and 2,800 cubic yards of gravel were removed. The tailings are retained on hill ground.

J. S. Day is the owner of 8 claims on the right limit above the mouth of Last Chance creek, and during the season of 1914 was hydraulicking on hill, right limit of No. 9 and bench, 2nd tier right limit, lower half, No. 9 above the mouth of Last Chance creek. The water is diverted from Last Chance creek and conveyed a distance of three miles by a ditch having a capacity of 200 miners' inches and applied under a pressure of 75 feet. The bank consists of gravel 50 feet. Water is available at intervals during the season from May 1st to October 1st and during the past season 4,000 cubic yards of gravel were removed. The tailings are dumped on hill ground.

The Dago Hill Mining Company are the owners of 52 claims on Last Chance creek and were hydraulicking on Discovery hill during intervals when water was obtainable. The water is diverted from Last Chance creek and conveyed a distance of 2½ miles by a ditch having a capacity of 200 miners' inches and applied under a pressure of 75 feet. The bank consists of gravel about 30 feet thick. Water is available only at intervals during the season and 4,000 cubic yards of gravel were removed. The tailings were dumped on creek discovery owned by the Company.

B. R. Elliott *et al* are the owners of 27 claims situated on the left limit of Hunker creek and left limit of Hester creek, a tributary thereof. The water is diverted from Hester and Independence creeks and conveyed a distance of about four miles by a ditch having a capacity of 200 miners' inches. The bank consists of gravel 40 feet thick. Water is available from May 1st to October 1st and during the 1914 season 10,500 cubic yards of gravel were removed. The tailings were dumped on creek No. 4, Hester creek.

Messrs. Gould and Murphy are the owners of 10 hill claims on the left limit of Hunker creek, and during the 1914 season were hydraulicking on hill, left limit Nos. 56 and 57 below Discovery Hunker creek. Water is diverted from Independence creek and conveyed a distance of three miles by a ditch having a capacity of 200 miners' inches and applied under a pressure of 50 feet. The bank consists of 25 feet of gravel. Water is available at intervals during the season from 1st May to 1st October, and 4,000 cubic yards of gravel were removed. The tailings are retained on hill ground.

August Larson *et al* are the owners of 30 claims, left limit of Gold Bottom and Hunker creeks and during the 1914 season were hydraulicking on Boreman bench, left limit No. 32 below Discovery, and on Curtis bench, 3rd tier, lower half, left limit, No. 33, below Discovery on Hunker creek. The water is diverted from Gold Bottom creek and conveyed a distance of two miles by a ditch having a capacity of 200 miners' inches and applied under a pressure of 50 feet. The bank consists of gravel 25 feet thick. Water is available from May 1st to October 1st and 12,000 cubic yards of gravel were removed.

Edward Blanchfield *et al* are the owners of 6 claims on right limit of Hunker creek and Little Gem creek, a tributary thereof, and are hydraulicking on this property. The water is diverted from Hunker creek, and conveyed a distance of three miles by means of a ditch having a capacity of 200 miners' inches, and applied under a pressure of 50 feet. The bank consists of 25 feet of gravel. Water is available from 1st May to 1st October and 2,800 cubic yards of gravel were removed. The tailings were dumped on creek claim No. 2 Little Gem.

Dominion Creek

The Dominion Mining Company, Limited, are the owners of 473 claims on Dominion creek and its tributaries. The water with which to carry on hydraulic operations is diverted from Dominion creek, and conveyed a distance of eight miles by means of a ditch having a capacity of 3,000 miners' inches, and from Portland gulch, a tributary of Dominion creek, and conveyed a distance of four miles by a ditch having a capacity of 500 miners' inches, and applied under a pressure of 75 feet. The operations consist of hydraulicking of an overburden of muck averaging about 8 feet in thickness. Water is available from May 1st to October 1st, and 382,399 cubic yards of muck and overburden have been removed. This material is carried away by the natural flow of water through Dominion creek.

The Big Creek Mining Company are the owners of 106 claims on Dominion creek below Lower Discovery. Water for the operation of these claims is diverted from Dominion creek and tributaries and conveyed a distance of 8½ miles by a ditch having a capacity of 3,000 miners' inches and applied under a pressure of 75 feet. The operations consist of hydraulicking muck of an average depth of 10 feet, and during the 1914 season 677,473 cubic yards of muck and overburden were removed. This material is carried away by the natural flow of water in Dominion creek.

The Calder Mining Company are the owners of 113 claims on Quartz creek and Indian creek. The water for the operation of these claims is diverted from Calder creek and conveyed a distance of 1½ miles by a ditch having a capacity of 1,000 miners' inches and applied under a pressure of 50 feet, also from Quartz creek and conveyed a distance of five miles by a ditch having a capacity of 1,000 miners' inches and applied under a pressure of 50 feet. The water is available from 1st May to 1st October and 484,269 cubic yards of muck and overburden were removed. This material is carried away by the natural flow of water in Quartz and Indian creeks.

Section of completed ditch, Dominion, creek, property of North-West Corporation, Limited

CHAPTER VII.

ORE DEPOSITS

Dawson Mining District

*ORIGIN OF THE PLACER GOLD

THERE is little doubt that the Klondike gold, or the greater part of it, at least, is detrital in origin, and has been largely derived from the auriferous quartz veins cutting the older schists and especially the igneous schists of the Klondike series. The veins are small and the number destroyed and concentrated as pebbles and boulders in the valley-bottoms is almost incalculable.

The derivation of the placer gold from quartz veins, as pointed out by Spurr in regard to the Fortymile district, is evident from the character of the grains. The greater part of the gold occurs in irregular flattened discs and bulbs very similar, when unworn, to those in the veins. Many of the grains and most of the nuggets inclose quartz, and a few are themselves inclosed in quartz. Pebbles and boulders speckled with gold are also occasionally found. A boulder from Bonanza creek, near Discovery, weighing sixty ounces, contained twenty ounces of gold. Additional evidence of the detrital origin of the gold is afforded by its worn character in the creeks, while the younger grains and nuggets found in the gulches are always rough and angular. The richest quartz, so far discovered, occurs near the head of Victoria gulch a tributary of Bonanza creek. The partially decomposed slide rock, which covers the surface of the hill side below the quartz outcroppings, contains colours of gold, and it is significant that Bonanza creek is rich below the mouth of Victoria gulch, and practically barren above. Victoria gulch is itself gold-bearing, and the gold obtained from near its head is sharply angular. It is not inferred from this that all the gold in Bonanza creek came from Victoria gulch, as none of the heavy gold has travelled far, and the valley was probably repeatedly enriched from veins along its course, and from the older gravels, but that some of it was so derived seems certain.

While the greater part of the placer gold has been derived from broken quartz veins, a small percentage may have been precipitated from water carrying gold in solution. A boulder was found on one of the workings on Miller creek, the upper surface of which was partially covered with thin specks and scales of crystalline gold. The crystals were arranged in a dendritic manner. Some of them were firmly attached to the rock, and others separated easily from

* Klondike Gold Fields, by R. G. McConnell, B.A. (No. 884).

Eldorado Creek

Country Rocks.—A few narrow diabase dikes cross the lower part of Eldorado creek, and narrow bands of dark graphitic schists were noticed in one or two places, but with these exceptions the valley is cut altogether out of the light-coloured micaceous schists on the Klondike series. Quartz veins are everywhere present, some carrying free gold.

Lone Star mineral claim, Victoria gulch

Hunker Creek

Country Rocks.—The rocks along the upper part of Hunker creek consist of the light coloured sericite schists and the greenish chlorite schists of the Klondike series, cut in places by small areas of recent volcanic rocks, principally andesites and quartz porphyries. From Colorado creek down nearly to Henry gulch, the dark quartz-mica schists of the Nasina series occur most frequently. An area of Tertiary sedimentary rocks, associated with andesite, outcrops at the mouth of Last Chance creek. Above Henry gulch, the rocks of the Klondike series reappear and continue to the mouth of the creek.

Dominion Creek

Country Rocks.—The rocks of Dominion creek have a greater variety than on the other creeks in the district. The upper part of the valley is cut through the grayish sericite schists of the Klondike series, alternating with bands of greenish chloritic schist. The latter is fairly massive in places, and is often filled with grains of pyrite and magnetite. In the central part of the creek, the Klondike schists are largely replaced by biotite-bearing schists, greenish schists and hard quartzose schists. Bands of dark graphite schists are also present, and limestones were found in the right bank opposite claim No. 123 below Discovery. These rocks resemble the schists on Indian river, and are referred to the Nasina series. The schists of the Klondike series come in again below Burnham creek, and are exposed down to a point midway between Gold-run and Sulphur creeks, where they are replaced by sheared granites, and these continue down to the mouth of the creek.

QUARTZ MINING OPERATIONS

The Lone Star

This property, which comprises four crown-granted claims and certain unpatented claims, is situated on the left limit of Victoria gulch, a tributary of Upper Bonanza creek, about sixteen miles from Dawson. The chief officers of the company are:—President, Dr. Wm. Catto, Dawson; secretary-treasurer, J. Henry, Dawson; and manager, E. H. Searle, Lone Star Mine.

Equipment.—One 4-stamp Joshua Hendy mill, with stamps arranged in two batteries, having automatic feed and triple discharge, and two 4½′ x 9′ plates for amalgamating.

A 50 H.P. general electric motor furnishes power from the transmission line attached to the power line of the Northern Light and Power Company, and, with this equipment, the power costs (at 4 cts. k.w.) about $1 per ton of ore crushed.

Method of Working.—The ore, which is much fractured to the depth worked in open-cut—approximately 18 feet—is easily mined. It is loaded into dump cars at the face of the cut, trammed to the raise which has been made from the drift below; dumped into a chute, and withdrawn by cars located in the lower level.

The cars are lowered by successive gears to the mill, situated about a thousand feet vertically below the mine and distant about 3,500 feet along the tramline.

The following extract from the report of the directors of the "Lone Star Limited," dated September 3, 1914, shows the scope of operations during the past year:—

". . . A considerable fault in the open-cut was encountered early this season which adversely affected the average value. This and a considerable fall

of surface waste in the open-cut, coupled with the limited means at the disposal of the directors, and the desire not to incur any large indebtedness, caused the directors to deem it advisable to suspend operations at the mine and mill on the 1st of August, 1914, and accordingly all wages men were paid off, although just before the suspension of operations the ground appeared to be regaining its normal appearance. Up to this time all the operations have been conducted with a view to development and to demonstrate that there is a large body of ore carrying such a value that, with a large and efficient plant, the ore would have an economic value and result in making the property of Lone Star, Limited, a valuable mine. That this assumption is reasonable seems to be borne out by the results obtained.

"All the ore mined and milled during the years 1912, 1913 and 1914 has been taken without selection out of a straight open-cut, on the surface which is now 40 vertical feet deep at the working face and 325 feet long. The rock is similar in nature and appearance in the tunnel 100 feet below the surface.

"During the years mentioned, viz., 1912, 1913 and 1914, 8,435 tons of rock have been mined and milled, yielding $24,977.55 or an average of $2.96 per ton. As this was all (except $2,008.71) saved by simple plate amalgamation, the company not having any fine grinding or cyanide plant, it is reasonable to conclude that the value of the rock must have been much larger than what was actually saved, as from time to time considerable sulphide rock was encountered. In August, 1913, the company hand picked nearly a ton of this sulphide rock, and it was forwarded to the Selby Smelting & Lead Company of San Francisco, who, on July 18, 1913, returned the weight as 1,864 pounds, with a total value of $2,008.71. The total expenses and charges were $162.89, and the Selby Company forwarded a cheque to the Lone Star Limited for $1,845.82. This approximates and confirms the estimate of value in the balance sheet for 1913. It is hoped that more of this rich rock will be eventually recovered.

"An addition to the mill house was made this season and the concentrator installed therein and it saves a clean concentrate."

In addition to the operations on the Lone Star, the following extract from a report dated the 29th of January, 1915 by the mining inspector contains the latest information regarding quartz development in the Dawson mining district:—

"Virgin" Mineral claim

"This property is located on Discovery Pup, a tributary of Bear creek. The discovery was made on an out-cropping of quartz in an old hydraulic cut. In the subsequent exploration work the lead was traced to a considerable distance and two shafts were sunk, one known as Discovery No. 1 to a depth of 35 feet and the other to a depth of 15 feet. The assays of ore taken from the lead proved so satisfactory to the owners that a small trial mill was erected on the property in the summer of 1913 known as "The Little Giant Quartz Mill," which is run in connection with a Dodge Crusher. The plant is electrically

driven, a transmission line about 2½ miles in length having been erected to connect with the Granville Power Company's line at their sub-station at the mouth of Bear creek. The management states that the mill is not proving satisfactory owing to its small capacity (four tons in 24 hours), and to some defect in the saving of the gold on the plates.

The mining of the ore is all done by hand work, and it is transported in cars a distance of about 500 feet along a track to a hopper erected at the head of a steel lined chute which connects with the ore bin at the mill. This method proves both satisfactory and economical. There are two tunnels driven in the hill, one above the mill at a distance of about 50 feet known as the No. 1 tunnel and is now driven 30 feet, the other is driven at the 232 foot level and is now in 150 feet. Several small stringers of quartz are exposed in each. Work is to be resumed in the tunnels and cross-cuts driven in expectation of striking the main ledge, and it is proposed to sink an inclined shaft following up the lead from the surface.

Other properties upon which considerable development work has been done are the "Red Hill" mineral claim situated on Gold Run creek, which would appear to contain prospects of remarkable value. About 75 feet of tunnel has been driven in rock in following up the lead. On the Box Car group situated at the head of Bonanza creek a shaft has been sunk to a depth of 65 feet.

The following statement was compiled by the gold commissioner at Dawson and shows the mining claims in good standing in the Dawson mining district in 1914:—

	Bonanza and tributaries.	Klondyke and tributaries.	Indian river and tributaries.	Yukon river and tributaries below Dawson.	Yukon river and tributaries above Dawson.	Total
Renewals for 1914	84	175	200	15	41	515
Locations for 1914	2	44	36	0	9	91
Patents issued in 1914	2	0	13	0	0	15
Patents issued prior to 1914	53	30	20	57	6	166
					Grand Total	787

In addition to the "Lone Star" and the claims mentioned in the report of the mining inspector, "Lode Mining in the Yukon" by T. A. MacLean, M.E., of the mines branch of the Department of Mines, contains a detailed description of the development work up to 1912 of the following promising quartz properties in the Dawson mining district:—

Eldorado Dome Quartz Mining Company, Limited

Eldorado Dome Quartz Mining Company, Limited, controls thirty-one mineral claims which adjoin the property of the Lone Star Company, Limited, and occupy the area which forms the southern and western slopes of the divide between Bonanza and Eldorado creeks on the one side, and Victoria, Oro Grande and Gay gulches on the other.

The Gordon mineral claim is situated on the right limit of Bear creek.

The Jean I. mineral claim is situated on the left limit of Bear creek.

The Violet group is situated on Eldorado creek.

The Lloyd group is situated at the head of Green and Caribou gulches, tributaries, respectively, of Sulphur and Dominion creeks.

Gold Run group is situated at the head of Gold Run creek and along the ridge on the right limit of Portland gulch.

The Patterson or Queen Dome group is situated on the divide between Portland and Lion gulches, both tributaries on the right limit of Dominion creek.

The Mitchel group extends over the summit of the divide between Gold bottom and the right fork of Hunker.

The Portland group is situated on the divide between Portland and Robinson gulches, tributaries of Dominion creek.

The Anderson claims are situated on Excelsior creek, which enters the left limit of Yukon river about fifty-three miles above Dawson.

The Duncan Creek Mining District

GALENA CREEK (SILVER LEAD PROPERTIES)

General Remarks.—Ninety-five claims have been staked and recorded in the Galena creek section and forty miners were prospecting during the winter of 1914-1915. These claims are situated on the left limit of the McQuesten river, and strike north easterly and south westerly along a bench that has an elevation of five or six hundred feet above the river valley. Since the first discovery of these claims the mining recorder at Mayo states that good progress has been made in prospecting and that considerable ore has been mined and shipped.

Silver King Mineral Claim.—This claim is situated on Galena creek. In February, 1915, ten men were employed taking out ore for shipment to the smelter

Mining scene on property of Lone Star, Limited, Victoria gulch

at Trail, B.C. The first shipment in 1914 showed that 46% was lead. Further development, however, shows that the greater the depth the higher are the values in silver. The vein averages four feet wide, and is six feet wide at the bottom of the shaft 150 feet deep. The foot wall or contact on the north west side is composed of a very hard quartzite and the hanging wall is composed of schist. The cost of mining, sacking and sorting this ore is $12.00 per ton. Mr. Thomas P. Aitken who owns and operates the property anticipates that further development will justify the installation of a mill at an early date.

Webfoot Mineral Claim.—This claim is situated on the right limit of Galena creek. Development work consists of one shaft 50 feet deep. A depth of 40 feet in this shaft is through muck and gravel.

Mabel Mineral Claim.—This claim is on the left limit of Galena creek and has three shafts. In two of the shafts veins or stringers carrying galena ore have been located.

Adam Mineral Claim.—Development work consists of two shafts 18 feet deep and a drift of 30 feet. The strike is in a north easterly and south westerly direction.

DUBLIN GULCH

Quartz Deposits.—* "At Dublin gulch, quartz veins occur, widely, throughout a fissured belt of schists, which lies along a generally well defined granite contact, striking northerly and southerly, along the ridge, above the left limit of Dublin gulch, and, towards the head of the gulch, running into Potato hills. These hills are rounded and steep, and are aptly named. They have an elevation of 5,400 feet, *i.e.*, some 2,000 feet, or more, above the mouth of Dublin gulch."

Stewart and Catto Group.—This property comprises six mineral claims situated on the divide between the Stewart and Olive pups, which enter Dublin gulch on the left limit about 1½ miles from its mouth. The work has been confined to the "Happy Jack" and "Victoria" mineral claims, and consists of two tunnels with drifts or cross-cuts, besides a large amount of surface trenches.

No. 1 tunnel is on the left limit of Olive pup, and is in about 200 feet with about 100 feet of cross-cuts and showing a vein with a width of 2½ to 6 feet.

No. 2 tunnel is situated about 300 feet higher up the mountain and has been driven in about 175 feet with about 70 feet of cross-cuts, and exposing a vein averaging 4 feet in width. The mining recorder reports that this vein carries gold values from $4.00 to $14.00 and picked samples over $100.00.

No. 3 tunnel, which is 100 feet in length, is situated on the right limit of Stewart pup.

The Olive Mineral Claim.—Development work consists of several surface trenches and one tunnel about 150 feet long and about 300 feet above the creek bed. This tunnel follows the vein, which has a width of from 5 feet to 12 feet, carrying values of from $9.00 to $50.00.

* Lode Mining in Yukon, by T. A. McLean, M.E., Mines Branch, Department of Mines (No. 222).

Shamrock Group.—This property comprises four claims. The development work consists of test pits and trenches and two tunnels, 35 feet and 150 feet respectively. No. 1 tunnel shows a vein averaging three feet wide, and No. 2 tunnel shows a vein of from 7 to 9 feet in width.

Blue Lead Group.—This property consists of eight claims. One shaft shows a vein six feet in width.

Eagle Group Mineral Claim.—A tunnel is being driven on this property. This group consists of eight mineral claims situated on Eagle gulch, a tributary on the left limit of Dublin gulch, about three-quarters of a mile from the mouth.

Samples taken from this group showed values up to $27.31 per ton.

Independence Group.—The claims comprising this property are located on the south-western slope of the divide, between Haggart and Secret creeks.

Whitehorse Mining District

*General characteristics of ore deposits

Distribution

"The copper belt, as determined by present discoveries, extends along the valley of the Lewes river, from a point east of Dugdale, on the White Pass railway, northwestward to the base of Mount Haeckel, a distance of about twelve miles. The width of the belt seldom exceeds a mile, and in places is confined to a single line. The distribution of the discoveries along the belt is exceedingly irregular. The croppings follow a series of limestone areas enclosed in granite, or lying between granite and porphyrite. Where the limestone is absent the belt is practically barren; and considerable stretches of it otherwise favourable, such as that extending from the Spring creek to the Pueblo claim, a distance of three and a half miles, are hopelessly buried beneath heavy accumulations of drift.

Ore Bearing Formations

The rock formations of the district consist, in order of age, of limestone, porphyrites, granites and grano-diorites, an extensive system of porphyrite dikes, and finally, basalts. Of these only the limestones and granitic intrusives are important economically. The principal ore bodies now being developed, occur in the limestone, close to or adjoining the granite. Numerous discoveries have also been made in the granite, often at considerable distances from the limestone. The limited work done on these has not so far disclosed ore bodies of commercial value. The constituent minerals, and general character of the ore bodies in the two formations, are very similar.

Copper minerals seldom develop in the porphyrites, but are not altogether unknown. The porphyrites are often closely interbanded with the limestones;

* "The Whitehorse Copper Belt," Yukon Territory, by R. J. McConnell (No. 1050).

and when this occurs in an altered area, both rocks are sometimes affected. The mineralization of the porphyrites is usually limited to a narrow zone, a few inches in width, bordering the limestone.

Principal Minerals

The principal economic minerals of the district are the two copper sulphides bornite, and chalcopyrite. Tetrahedrite occurs at the Arctic Chief, and small bunches of chalcocite at the Best Chance, and other places. Copper minerals resulting from the oxidation of the sulphides are conspicuous at all the workings; but except at the Pueblo, are seldom important as ores. They include the two copper carbonates, malachite and azurite, the red and black oxides cuprite and malaconite, and the silicate chrysocolla. The cuprite is occasionally associated with small grains of native copper.

The iron sulphides are not abundant and nowhere form large masses. Scattered grains of pyrite occur in the granites, altered limestones, and more frequently in the porphyrites, but are rarely found in connection with the ore bodies. Small quantities of pyrrhotite occur at the Arctic Chief. It was not observed elsewhere.

The iron oxides, magnetite and hematite, on the other hand, are widely distributed, and both occur in large masses. Magnetite is especially abundant, and is seldom absent from the mineralized areas. Lenses of this mineral, ranging in size from a few inches to 360 feet in length, are found all along the belt, mostly in the altered limestones, but also occasionally in the altered granites. Hematite is less common. It occurs in large tabular crystals at a number of the showings, and is the principal mineral in the great Pueblo lode.

Other metallic minerals of less frequent occurrence are, arsenical pyrites, stibnite, galena, sphalerite, and molybdenite. Gold and silver in some quantity occur in all the ores. The values range from traces up to several dollars per ton. Gold is occasionally found native.

The principal non-metallic minerals accompanying the ores are garnet (andradite), augite, tremolite, actinolite, epidote, calcite, clinochlore, serpentine, and quartz. Of these, garnet, augite, calcite, and tremolite, are the most abundant. Quartz is sparingly distributed, and seldom occurs in quantity.

ORE BODIES

The ore bodies fall into two classes: those in which the copper minerals are associated with magnetite and hematite, and those in which various silicates, principally garnet, augite, and tremolite, are the chief gangue minerals.

The magnetite ore bodies are numerous, and occur enclosed completely in altered limestone, along the lime-granite contact, and in a few instances, in areas of altered granite. The largest bodies so far discovered are, the Best Chance, 360 feet in length; the Arctic Chief, 230 feet; and the Little Chief, 100 feet. The magnetite masses are always sprinkled more or less plentifully throughout

with grains and small masses of bornite and chalcopyrite. The two sulphides occur, both separately and intergrown, and are of the same age as the enclosing magnetite. The copper percentage varies greatly in different parts of the same lode, the general average approximating four per cent. The gold and silver are negligible in some of the ore bodies, and important in others.

Besides the copper minerals, serpentine, calcite, clinochlore, and other secondary minerals, are often associated with the magnetite, and rarely, pyrrhotite and sphalerite.

Hematite masses are much less common than magnetite, only one large body being known. This is the Pueblo lode, on Porter creek. The upper explored portion has developed altogether in limestone. Granite outcrops in the vicinity, but its contact with the limestone is concealed by drift. It differs from the magnetite ore bodies principally in the greater oxidation of the copper minerals. It is more porous, and the original sulphides or sulphide have been largely converted by surface waters into carbonates, oxides, and silicates. Some chalcopyrite survives in portions of the lode. No bornite has been found.

Showings characterized by a garnet-augite-tremolite gangue are numerous wherever the lime-granite contact is exposed. They vary in size from a sprinkling of copper minerals to considerable lenses of shipping ore, such as those developed on the Grafter, Copper King, War Eagle, and Valerie. All the important ore bodies of this class, so far discovered, occur in the limestone, close to the granite, and are often separated from the granite by a zone of more or less completely replaced limestone. The valuable minerals are similar to those in the iron masses, and consist mostly of bornite and chalcopyrite, carrying small quantities of gold and silver. At the Valerie, bornite is absent, and the chalcopyrite is associated with mispickel, the only known occurrence of this mineral in the camp.

The ore bodies of this class are occasionally tabular in shape, and have the appearance of following particular limestone beds; but in most cases the outlines are very irregular. The Copper King and Valerie lodes are short and blunt, while that on the Grafter, as shown in the present workings, is shaped like a horseshoe, and partially encircles a core of unreplaced limestone. The copper minerals at the Grafter and Copper King stop rather abruptly against a marble foot-wall; but as a rule they have no definite limit, and extend in diminishing quantities for some distance beyond the valuable portions of the lode. In some instances, as on the Anaconda, the ore alternates with bands of limestone, and limestone replaced by garnet and augite."

In a report dated the 25th of June, 1915, concerning the development of quartz claims in the Whitehorse mining district, the assistant gold commissioner at Whitehorse states:—

Only two of the quartz claims dealt with were operated last year, *i.e.*, the "Pueblo" and "War Eagle." The former continued its main shaft from the 250-foot level to 450 feet and shipped over 60,000 tons of ore, mainly from work-

ings then under way. About 3,000 cords of wood were consumed in doing this. On the "War Eagle" there was, last year, a shaft sunk 100 feet, besides 300 feet of drifting. As hand work obtained there was but little wood consumed.

"Pueblo" Mineral Grant.—Located 6½ miles west of Whitehorse. The property embraces seven claims, the whole comprising 422.01 acres. The development work comprises a shaft 450 feet deep; drifts, 3,000 feet, rises, 500 ft. 40,000 tons of ore were taken from a surface open-cut; and over 100,000 tons of

Coal mine and power house, Northern Light, Power and Coal Company, Coal creek

ore were shipped. The plant includes 3, 150 h.p. boilers, 1 Ingersoll Rand compressor, 2, 100 ft., 1 large single drum, Ledgerwood hoist, completely equipped machine shop, etc. Ore treated, 100,000 tons at Tacoma smelter. Length of vein uncovered, 700 feet. Ore in sight, 250,000 tons. Vein is lenticular. Average width of ore body, 25 feet. Strike northerly. Dip westerly.

"War Eagle" Mineral Claim.—Located 7 miles west of Whitehorse. Comprises an area of 132.33 acres. Shaft 100 feet, shaft 85 feet, drifts 300 feet. Vein uncovered, 125 feet. Ore in sight 5,000 tons. Walls lime and diorite. Ore body about 25 feet wide. Strike northerly. Dip westerly. Only a few tons of ore shipped and treated.

"Montana" Group Silver Claims.—Located on west shore of Little Windy arm, 11 miles south of Carcross. Property embraces 5 claims, covering 245 acres. Shaft, 300 feet; tunnel, 400 feet. Plant includes aerial tram, 4 miles long; hoist, compressor, etc. Ore treated, 600 tons. Ore smelted at Tacoma and Ladysmith smelters. Average width of ore body, 4 feet. Strike, northwesterly. Dip, southwesterly.

"Venus" Group Silver Claims.—Located on Little Windy arm, 12 miles from Carcross. Property embraces 8 claims, 345 acres. Tunnels, 1,700 feet, shafts, 500 feet, drifts, 1,000 feet, upraises, 500 feet. Concentrator, 100 tons per diem, aerial tram, 1½ miles, compressor, hoist, etc. Ore treated, 6,000 tons. Smelted at Ladysmith and Tacoma smelters. Ore in sight estimated at 25,000 tons. Fissure vein. Walls, granite. Average width of ore body, 4½ feet. Strike, northwesterly. Dip, southwesterly.

"Copper King" Mineral Claim.—Located 4 miles west of Whitehorse. Two mineral claims covering 91.05 acres. Tunnel 400 feet, shaft, 90 feet, upraise, 100 feet. Plant composed of boiler, hoist and compressor. Ore treated, 1,000 tons at Ladysmith smelter. Length of vein uncovered, 300 feet. Ore in sight, 1,000 tons. Lenticular veins. Average width of ore body, 5 feet. Strike northerly. Dip westerly.

"Big Thing" Group Silver Claims.—Located 7 miles south of Carcross. Property embraces 7 claims, comprising 284 acres. Main tunnel, 2,200 feet, main shaft 400 feet, upraises 600 feet, drifts, 1,000 feet. Plant, two 60 h.p. boilers, electral power plant, two compressors, hoist, etc. Ore treated, 3,000 tons. Ore smelted at Ladysmith and Tacoma smelters. Length of vein traced, 750 feet. Ore in sight, 10,000 tons. Fissure vein. Walls, granite. Average width of ore body, 4 feet. Strike, north-west. Dip, north-west 23°.

"Grafter" Mineral Claim.—Located about 7 miles south-west of Whitehorse. Comprises one claim covering 47.24 acres. Shaft, 100 feet deep. Plant includes one 25 h.p. boiler, hoist, compressor and two pumps. Ore treated, 2,000 tons. Smelted at Tacoma smelter. Vein uncovered, 126 feet. Ore in sight, 6,000 tons. Lenticular veins. Walls lime and diroite. Average width of ore body, 12 feet. Strike northerly. Dip westerly.

"Anaconda" and "Rabbit's Foot" Mineral Claims.—Located 4 miles northwest of White horse. Property embraces 3 claims covering 114.44 acres. Two shafts of about 35 feet each, and several hundred feet of surface work. Veins uncovered, 1,000 feet. Appear to be ordinary veins. Average width of ore body, 15 feet. Strike northerly. Dip westerly. About 200 tons of ore mined recently, and now in transit to the Tacoma smelter.

"Arctic Chief" Mineral Claim.—About 7 miles south-west of Whitehorse. Three claims embracing 132.33 acres. 3,000 feet of tunnel and upraises. Length of vein uncovered, 200 feet. Ore in sight, 10,000 tons. Lenticular veins. Strike northerly. Dip westerly.

"Valerie" Mineral Claim.—About 7 miles south of Whitehorse. One claim comprising 46.21 acres. Shaft, 200 feet deep. Plant, one boiler and hoist.

Vein uncovered, 75 feet on 100-foot level. Ore in sight, 5,000 tons. Lenticular veins. Average width of vein, 12 feet. Strike northerly. Dip westerly.

*Wheaton District

The ore deposits of the Wheaton district are classified by Mr. Cairnes as follows:—

(a) Gold-silver quartz veins.
(b) Antimony-silver veins.
(c) Silver-lead veins.
(d) Contact-metamorphic ore-deposits.

DETAILED DESCRIPTIONS

The Vein-fissures

"The gold-silver quartz veins are of two types, each restricted in its occurrence to one type of rock. These are (1) simple gold-quartz veins in the Jurassic granitic intrusives, (2) lenticular veins in the Mt. Stevens schists. These two types contain similar minerals, belong to the same vein-system, and are contemporaneous in formation. Their differences are due, as will be explained later, to the effect of the containing rock on the formation of the fissures.

Distribution

"The majority of these fissures are limited in Wheaton district to a belt 16 miles long by two miles wide. This belt extends in a south-easterly direction from Watson river, on the north, to the southern portion of Mt. Stevens, which are points at the north and south edges, respectively, of Wheaton district. Ten miles farther to the south-east, and in line with the general direction of this mineral belt, are a number of similar veins, in Windy Arm district. Also, ores which probably belong to this class are reported to have been found to the north of Watson river and in a line with those known to the south. So that when this portion of southern Yukon has become more explored it will probably be found that these veins exist throughout an area greatly in excess of that existing in Wheaton district.

The narrow belt above described includes portions of Mt. Stevens, Tally-Ho mountain, Wheaton mountain, Gold hill, Hodnett mountain, and Mineral hill. In addition, a few veins have been found some distance on either side of this area. The most distant of importance, so far discovered, is that seen on the Rip, and Wolf claims on Mt. Anderson, about 4 miles to the west of the main belt. Veins were also noted on the eastern end of Red ridge and elsewhere, 2 to 3 miles to the east of this belt. So that altogether these fissures occur throughout an area

*Memoir No. 31, Wheaton District, Yukon Territory, by D. D. Cairnes, Geological Survey Branch (No. 1228). A complete description of the ore deposits of the Wheaton district is contained in Mr. Cairnes' report.

of 8 or 9 miles wide, extending to the west to include Mt. Anderson, and to the east to the eastern edge of Red ridge.

Formations in Which the Fissures Occur

These ore fissures occur in the Coast Range intrusives which are chiefly granites and granodiorites, and also in the chloritic and sericitic schists and greenstone-schists of the Mt. Stevens group."

General

"*Classification of Antimony Ores.*—These antimony-silver veins belong to an unusual type of ore-deposit, known in but few localities in the world, and occupy a somewhat unique place in the classification of antimony ores. To bring out the connexion between these and other related ores, the following classification is offered, under which it is believed all antimony ore-deposits so far discovered can be conveniently placed. It is not intended, however, to include deposits containing only insignificant percentages of antimony-minerals, which belong properly to gold, copper, or other types of ores.

Classification of antimony ore-deposits:—

I. Fissure-veins and other ore-containing cavities.
   (*a*) Those that are valuable chiefly, or entirely, for their antimony-content.
   (*b*) Those that are notably gold-bearing, the stibnite being auriferous.
   (*c*) Those containing both antimony and silver in economically important amounts.
II. Metasomatic replacements.

Most deposits of antimony ores belong to division I. Those coming under division II occur chiefly in limestone formations, and have been found in very few localities. With few exceptions, the ores of division I belong either to subdivisions (*a*) or (*b*), which have themselves been separated almost wholly for practical reasons. In the one case (*b*), the ores are mined chiefly for gold, and when treated seldom yield any returns for their contained antimony. In the other case (*a*), the ores are worked mainly or entirely for their antimony content. The veins of these two types are closely related, and grade into each other. These ores of subdivision (*a*) represent merely the extreme, or gold-poor, facies of the deposits of division I.

Detailed Descriptions

The Vein-fissures.—Distribution.—The fissures containing these antimony-silver veins, so far as has been discovered, are limited, in Wheaton district, to a

Memoir No. 31, Wheaton district, Yukon Territory, by D. D. Cairnes, Geological Survey Branch (No. 1228).

View of Yukon Gold Company's plant and C. K. M. Co. Dredge No. 4. Taken from Acklen Farm, September 9th, 1913. Printed August 2nd, 1914

westerly trending belt, 5 miles long by 1½ miles wide. This area includes the central portion of the eastern face of Chieftain hill and a zone extending through Carbon hill from its extreme western to its eastern edge. The greater number of these ore-containing fissures, however, have been found on the western face of Carbon hill, and are included in an area not more than a mile in diameter. Further prospecting may considerably extend the boundaries of this mineral belt, as but little search for ore has been made in the surrounding district, throughout much of which the geological conditions appear to be similar to those on Carbon and Chieftain hills.

Formations in Which the Fissures Occur.—These fissures occur in the jurassic coast range granitic rocks, and in the andesites and andesitic tuffs and breccias of the Chieftain hill volcanics which are of late cretaceous or early tertiary age. The most persistent fissures, and those containing the richer silver ores, have been found, so far, chiefly in coast range granodiorites. Otherwise, the ores occurring in the fissures of the different rocks just mentioned are practically indistinguishable."

Upper White River District

*Lode deposits

Occurrences

"Gold-bearing lode deposits occur in Upper White river district, mainly on Baultoff mountain and vicinity, and along Beaver and Rabbit creeks. A considerable number of mineral claims have been staked on these various deposits at different times, the greater number of the locations having been made since the spring of 1905. Quite a number of claims have also been located at various points throughout the district, on which there is no evidence of a deposit of economic or ore minerals of any description.

On the greater number of the gold-bearing, or presumably gold-bearing quartz locations throughout the district, no development of any kind has been performed, and consequently these claims have lapsed. On a few, there is evidence of a slight amount of work, possibly amounting to about one year's assessment.[1] But so far as could be learned on only three properties on the Canadian side of the Boundary line, has more than this small amount of development been performed; on these in addition to some surface cuts and shallow pits, adits have been commenced and have been run from 10 to 30 feet respectively. One of these properties is situated on Beaver creek and the other two are located on Rabbit creek.

* Memoir No. 50, Upper White River District, by D. D. Cairnes (No. 1385).

[1] According to the mining laws of Yukon Territory,one hundred dollars worth of work must be expended on each mineral claim each year to hold the same, until it is crown granted, or in lieu of this work, one hundred dollars in cash may be paid to the mining recorder of the district in which the claim is situated.

Baultoff Mountain and Vicinity[2]

On Baultoff mountain a number of quartz deposits form prominent outcrops, and, as the quartz is somewhat iron-stained and in places occurs along the summits of the higher ridges, the reddish or yellowish exposures can be distinguished for a long distance. The quartz also occurs dominantly in the shales and related sediments, but in places has been deposited along the contacts between these rocks and the intrusive volcanics which have so extensively invaded the older sedimentary formations in this vicinity.

Near the summit of the mountain and along the top of a sharp ridge, a mass of quartz is exposed which is about 150 feet in width. This deposit, however, appears to be lenticular in form, and could not be traced for more than 50 to 100 feet on either side of the summit of the ridge. The greater number of the other quartz deposits in this vicinity range from about 4 to 12 feet in thickness, but were rarely traceable for any considerable distance, and appear in the majority of cases to narrow rapidly in either direction along their strike. An occasional vein is, however, more persistent, and as an example, on the south of the mountain near the head of a small creek draining toward the east into Beaver creek, a vein of solid quartz is exposed for several hundred feet, which strikes in a northerly direction cross-cutting the stratification of the country rock, and is throughout from 6 to 12 feet in thickness. A number of smaller fissure veins were also noted which appear to be quite persistent but are dominantly less than 12 inches in thickness.

The quartz of these deposits is all very sparsely mineralized and in most places exhibits only a slight iron coloration. Copper stains (malachite and azurite) also occur, and occasional rare particles of pyrite and chalcopyrite were noted. Although none of these deposits on Baultoff mountain, particularly under existing conditions, would appear to warrant development, it would seem quite possible that in a mineralized district, where quartz is so abundant, deposits may occur which have not yet been discovered, that contain sufficient gold, copper, or other minerals to pay for mining. With this possibility in view, therefore, further prospecting in this vicinity is recommended.

In addition to the quartz deposits, claims have also been staked along certain iron-stained, sheared zones traversing the volcanic rocks of this mountain. One such band or zone is about 200 feet wide and has the appearance of a greenish to reddish, somewhat schistose rock. A typical specimen examined under the microscope proves to be much altered, mashed, and somewhat sheared, and appears to have originally been an andesitic tuff. It consists mainly of plagioclase rapidly altering to calcite, and also contains some quartz and occasional particles of iron-ore minerals. As an ore deposit this does not appear to possess any economic value."

[2] Moffit, F. H., and Knopf, Adolph, " Mineral resources of the Nabesna-White Rivers district, Alaska ": U. S. Geol. Surv., Bull 417, 1910, pp. 59, 60.

COPPER

General Occurrences

*"Native copper has long been known to occur in White river basin, and the reported occurrence of this metal in vast quantities was the incentive that originally drew the prospector into this region. The first definite information, however, concerning its exact whereabouts or quantities is contained in Hayes' report of a trip he made from Selkirk to Skolai pass in 1891 in company with Lieutenant Schwatka and a prospector named Mark Russell.[1] The Indians previous to this time, had carried on quite a traffic in native copper which was used for arrow heads, knives, cooking utensils, and also for bullets where lead could not be obtained. While at Selkirk, the members of the Hayes' expedition were told of masses of native copper as large as houses, and Indians were secured who promised to guide the party to these fabulous deposits. As the locality was approached, however, the copper masses grew gradually smaller and when their source on Kletsan creek was finally reached what were shown 'consisted of small nuggets, the largest only a few ounces in weight.'[2] Hayes further states —"Some time was spent in searching for the source of the copper in Kletsan creek, but without success, as we soon reached the snow line, beyond which of course, further search was impracticable. It appears to have been brought by glaciers from the region toward the south which is still covered by snow and ice."[3]

Kletsan creek is a small stream which heads in Natazhat glacier in the vicinity of the International Boundary line, about 14 miles south of White river. It flows in a northeasterly direction until about 2¼ miles east of the Boundary, when it changes its course and follows a northwesterly trend, crossing the Boundary about 5½ miles south of the White, whence it continues to the north joining this river at a point about one-half mile within Alaskan territory. Thus, the greater portion of this stream, including its upper course, which is below Natazhat glacier, and in which the placer copper has been mainly discovered, is within Canadian territory, but some miles to the south of the district mapped during the past summer (1913).

In 1899, the placer copper deposits on this stream were visited by Brooks in the course of his trip from Pyramid harbour to Eagle City, and as this locality is within Yukon territory, and as his report[4] contains the most recent known published account of this occurrence that is of a reliable nature, a couple of paragraphs from his descriptions will be here quoted. These deposits, whether of economic importance or not, are of particular interest as they constitute possibly the first known occurrence of copper in White river basin of either Yukon or Alaska. Brooks states: "The placer copper deposits (all native)

* Memoir No. 50, Upper White river district, by D. D. Cairnes (No. 1385).

[1] Hayes, C. W., "An expedition through Yukon district": Nat. Geog. Mag., Vol. IV., 1892, pp. 143-145.

[2] Idem, p. 143.

[3] Idem, p. 144.

[4] Brooks, A. H., "A reconnaissance from Pyramid harbor to Eagle City, Alaska": U.S. Geol. Surv., 21st Ann. Rept., Pt. II., 1899-1900, pp. 379-381.

are contained in stream benches that owe their existence to rock barriers through which the streams have now cut their courses. The placer copper, as far as observed, is confined to a distance of about half a mile above the point where the creek leaves its rocky canyon. The placer copper is irregularly distributed on the bed-rock in the crevices and also among the large boulders. The nuggets found by the Indians who accompanied me seldom exceeded a few ounces in weight, although one was found which weighed five or six pounds, and another which I saw from the same region weighed 8 or 10 pounds. The Indians dig the copper with caribou horns, and by this primitive method of mining must confine their efforts to the recent stream cuttings.

"As far as the limited time would permit a careful search was made for evidence as to the source of this native copper. An examination of the greenstones showed them to be traversed by an irregular system of joints, and calcite veins were observed which followed these joints. A careful examination showed that some of these veins carried native copper. These copper-bearing veins were found close to the contact with the limestones. Calcite veins also found in the white crystalline limestone near the contact with the greenstones. A superficial examination of the greenstones showed that they are of a dioritic character and are cut by a series of aphanitic dykes, which are provisionally classed as diabases. The presence of amygdaloidal greenstones (probably andesites) and some tufas among the stream gravels suggest that these basic intrusives may be the feeders of apophyses of outpourings of volcanic rocks. No other copper minerals, except secondary malachite, were found during the day spent in investigating the deposits. In the western extension of the copper belt amygdaloidal greenstones carrying amygdules of copper pyrite and various gangue minerals are not uncommon. To the east the Kletsan copper belt was traced only to the vicinity of the International boundary. Its eastern extension beyond this point, if it exists, is to be sought north of our route of travel. To the west the same zone seems to extend to the Upper White river." [1]

Moffit and Knopf also state concerning these Kletsan creek deposits: "In 1902, a number of years after this examination, which was necessarily of a hasty character, some attempt was made by Mr. James Lindsay to test the placer copper possibilities of the locality. On account of the glacial ice and snow on the high ranges at the head of the creek and a number of other adverse conditions, unfavourable conclusions were reached." [2]

Since 1898 prospectors, largely due to Indian reports, have been coming into White river district in search of gold and copper, the natives having invested the region with richness proportionate to its remoteness and inaccessibility. Prospecting in search of copper has shown that this metal is widely distributed in the portion of the White river basin lying to the west of the International boundary and that native copper also occurs there as nuggets in the gravels of many of the streams. Deposits of native copper and associated minerals also

[1] Idem, p. 381.

[2] Moffit, F. H., and Knopf, Adolph, Op. cit., p. 57.

occur on the Canadian side of the boundary line, in Upper White river district, but by far the greater number of discoveries have been made in Alaska; and as the deposits there are in places much better exposed, and are in some cases also, more extensively developed, and are consequently better understood, a few facts concerning these Alaskan deposits will be here included, in the hope that a knowledge of such may be of value to persons interested in or exploiting the adjoining portions of Yukon across the boundary line.

During the summer of 1908 Moffit and Knopf investigated the mineral resources of the Alaskan portion of the White river basin and have contributed the most recent and comprehensive description of the copper deposits of that region. The writer can, therefore, not do better than quote from these authors, who state with reference to the White-Nabesna region: "Copper in its bed-rock sources is widely distributed in the form of sulphides (chalcocite, bornite, and chalcopyrite), and on the basis of the facts revealed by the little development work that has been done it may be stated that most of the native copper found in the region is an oxidation product of those sulphides. Some primary native copper, however, has undoubtedly been discovered. In mode of occurrence the copper ore shows two different habits, geologically distinct. In one, so far the better known it occurs associated with the Carboniferous basaltic amygdaloids; in the other it is found in limestone at or near the contact with the dioritic intrusives.

"Native copper occurs as nuggets in the gravels of many of the streams, and green-coated lumps of metal, up to 5 pounds or more in weight, are occasionally found in the wash of creeks draining areas of amygdaloid bed-rock. . . .

"Metallic copper occurs also in the surface croppings of sulphide deposits in the amygdaloids, where it is undoubtedly an oxidation product of the sulphides that appear in depth. In such places it is directly associated with the dark-red oxide (cuprite) and more or less green carbonate. . . .

"At a few localities native copper is associated with certain highly amygdaloidal portions of the Carboniferous basalts and intergrown with the white minerals that fill the former steam cavities in the ancient lava flows. Slaggy-looking portions produced by the weathering and removal of the amygdules from the lava, and amygdaloid that is cut by small irregular veinlets filled with the same minerals as those forming the amygdules appear to be the most favourable places for metallic copper. The copper in the vesicles and stringers is associated with calcite and delicately spherulitic prehnite, but in some of the veinlets calcite, prehnite, quartz, a black lacquer-like mineral, partly combustible, and chalcocite, instead of metallic copper, are associated together.

"At a number of places throughout the region narrow stringers of chalcocite cutting the ancient basalts are encountered, but so far as known they have no great persistence. . . .

"At other localities some irregularly disseminated sulphides, in some places chalcocite, in others bornite, occur in the basalts, but these do not appear to be connected with definite vein or lode systems and are consequently of an unencouraging character. Oxidation of these sulphides and disintegration of

the containing rock give rise to the nuggets of cuprite and native copper that are found in the talus slopes at several localities in the region.

"In contrast to these occurrences, which, as shown by the foregoing discussion, are limited to the ancient basalt flows, copper is found as bornite and as chalcopyrite intergrown with contact-metamorphic rock in limestone adjoining diorite intrusives. In deposits of this type the ore mineral is associated with garnet, coarsely crystalline calcite, epidote, specular hematite, and scattered flakes of molybdenite. . . .

Only two deposits of this character were seen in place, but evidence of energetic contact metamorphism was detected at a number of other localities." [1]

In conclusion these writers further state: "The main interest of the White-Nabesna region has centred in the occurrences of native copper. No phenomenal ore bodies have yet been discovered, but it has been shown that some primary native copper occurs in the amygdules of zeolitic amygdaloids. . . .

This discovery is sufficiently encouraging to warrant further development, and it is to be hoped that the nature and extent of the deposit will soon be demonstrated.

"From the descriptions given in the preceding pages it will be apparent that a lode-quartz region of some promise has been discovered in the Nutzotin mountains near the International boundary and that as yet it has been but imperfectly explored by the prospector." [2]

The volcanic rocks which are the chief copper carriers in the White-Nabesna district, are also somewhat extensively developed across the International boundary in Upper White river district. Unfortunately, however, in Yukon the particular amygdaloidal lava flows which have proved to be the main source of the copper, appear in part at least to underlie the superficial deposits of the White river valley and are thus very difficult to discover. Native copper is, however, also apparently extensively developed along the edge of the St. Elias mountains to the south as evidenced by the Kletsan creek placer deposits, but there the bed-rock occurrences appear to be too high in the mountains for economic working.

Thus, up to the present, so far as is known, copper deposits associated with these old lavas that are of economic importance have been found on only one property on the Canadian side of the line. This property, which is situated on the south side of White river near Canyon City, is known as Discovery copper grant. Native copper and copper minerals are, however, also reported to have been found on Generc river to the east, and at several points in the vicinity of the Upper canyon on White river, copper stain and occasional particles of native copper have been found in reddish amygdaloidal lavas. Near the mouth of Boulder creek, for instance several claims have been located, but although some native copper is claimed to have been discovered there, the only copper minerals

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[1] Moffit, F. H., and Knopf, Adolph, "Mineral resources of the Nabesna-White Rivers district, Alaska": U.S. Geol. Surv., Bull. 417, 1910, pp. 52-54.

[2] Idem, pp. 61-62.

the writer could find consisted of occasional patches of copper stain in the amygdaloids. As before mentioned, also, old reddish amygdaloidal lava flows of the same age, apparently, as the copper-bearing flows of Alaska, are developed at a number of points in Upper White river district, as described in the section of this memoir dealing with general geology, and all such lavas are liable to contain copper. Further prospecting in this district is thus recommended, as it would appear to be possible that copper deposits may yet be found to be quite extensively developed on the Yukon side of the Boundary line."

CHAPTER VIII.

*COAL-BEARING FORMATIONS

THE coal-bearing formations of Yukon are all of either Tertiary or Jura-Cretaceous age—the mineral fuels in the Tertiary beds throughout the territory being lignites, characterized in most places by the presence of considerable amounts of fossil resin or amber, while those of Juro-Cretaceous age range from high-grade lignite to anthracite.

Tertiary coal-bearing beds do not cover very extensive areas, but have a somewhat wide distribution and, in places, apparently constitute remnants of once larger areas now infolded with other terranes; in most cases, however, they represent deposits laid down in separate basins of deposition. The fossil plant remains found in these beds, show that most of them, at least, are of fresh-water origin. These lignite-bearing Tertiary beds appear to belong to the Kenai series, which is the oldest known Tertiary in Yukon and Alaska and is generally referred to the upper Eocene. These rocks are, in most places, but little disturbed, although locally they have suffered considerable deformation. They consist, typically, of light-coloured, slightly coherent conglomerates and sandstones and dark to light-coloured, soft shales and clays. In places volcanic materials occur associated with these sediments.

The Jura-Cretaceous sediments consist mainly of conglomerates, quartzites, sandstones, greywackes, arkoses, tuffs, shales, and slates, having a wide range of colour and differing greatly in the amount of metamorphism they have suffered. In general they are considerably more indurated, and the beds have been much more disturbed than those of Tertiary age. The Jura-Cretaceous beds appear to be remnants of former extensive areas which were originally all connected but have been reduced by erosion to their present proportion. In southern Yukon where these beds have been studied, the uppermost member, the Tantalus conglomerate, is composed dominantly of cherty conglomerate beds which have an aggregate thickness of at least 1,000 feet (300 m.). The underlying Laberge series has an average thickness of about 3,800 feet.

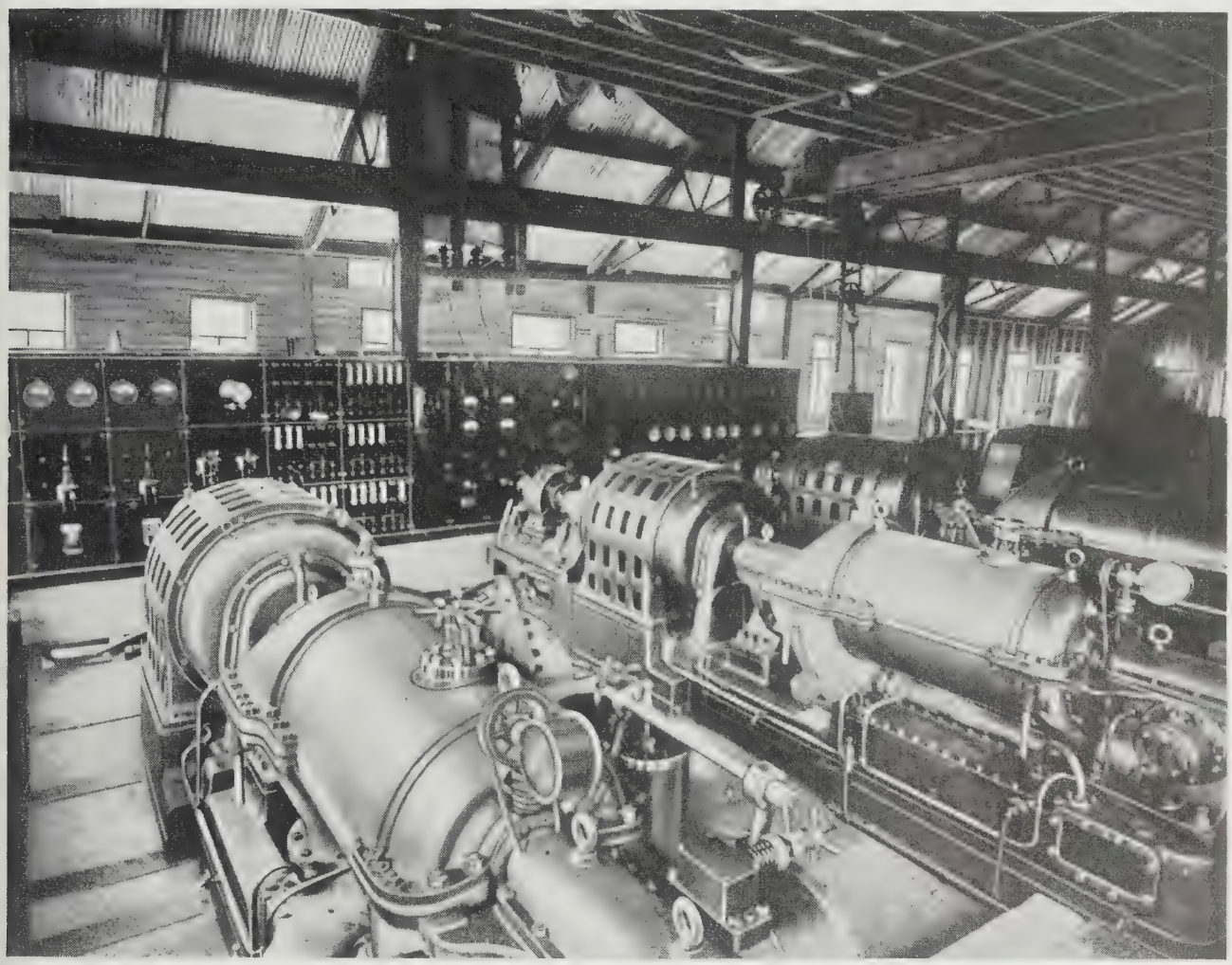
In the Jura-Cretaceous beds, two distinct coal horizons have been recognized. The upper horizon occurs well up in the Tantalus conglomerates, and the lower horizon is in the Laberge rocks, within a zone 200 to 300 feet (60 to 90 m.) below the Tantalus conglomerates.

The beds found to be coal-bearing in Yukon occur in at least eighteen distinct areas. In thirteen of these, coal of economic importance has been discovered, and may yet be found in the remaining five.

* By D. D. Cairnes. Reprinted from Coal Fields and Coal Resources of Canada, by D. B. Dowling.

The following table gives the extent of these rocks:—

Extent of known Tertiary beds in Yukon	2,090 sq. miles (5,410 sq. km.)
Extent of known Jura-Cretaceous beds in Yukon	4,110 sq. miles (10,650 sq. km.)
Totals	6,200 sq. miles (16,060 sq. km.)
Probable extent of Tertiary beds in Yukon	4,500 sq. miles (11,600 sq. km.)
Probable extent of Jura-Cretaceous beds in Yukon	19,700 sq. miles (50,000 sq. km.)
Totals	24,200 sq. miles (61,600 sq. km.)



Interior of Northern Light, Power and Coal Company's Power House, Coal creek

Character of the Coal

At only five points in Yukon has coal actually been mined, viz., on Cliff creek, on Coal creek (tributary of Yukon river), on Coal creek (tributary of Rock creek), at Five Fingers mine, and at Tantalus mine. The first three of these occur in the Rock Creek Tertiary basin, and the last two are situated within the Tantalus Jura-Cretaceous area. At two or three other points the measures have been prospected. The only two mines that have been in operation since 1908 are the Sour Dough mine on Coal creek (tributary of the Yukon) and the Tantalus mine situated on Lewes river about midway between Whitehorse and Dawson.

The following table gives the analyses of a number of typical coals from different parts of the territory:—

Locality	Age	Hygroscopic water	Volatile combustible matter	Fixed carbon	Ash
		%	%	%	%
Cliff creek	Tertiary	8.57	42.04	45.77	3.62
		10.58	40.10	46.74	2.58
Sour Dough mine	Tertiary	17.10	34.50	38.40	10.00
		14.57	33.11	37.15	15.17
Coal creek, tributary of Rock creek		18.31	34.96	40.88	5.85
		19.37	33.85	37.54	9.33
Five Fingers mine	Jura-Cretaceous	5.95	40.46	45.16	8.43
Tantalus butte	Jura-Cretaceous	13.64	31.83	51.84	2.69
		12.87	31.72	49.51	5.90
Braeburn-Kynocks area	Jura-Cretaceous	8.98	29.62	48.30	13.10
		12.02	34.28	42.56	11.14
Whitehorse area	Jura-Cretaceous	2.15	6.01	69.86	21.98
		3.76	8.34	65.50	25.40

Average samples of 500 pounds (226 kilograms) each from the three seams being worked at the Tantalus mine have been analysed with the following results:

	Upper seam Average thickness 3 feet (0.9 m.)	Middle seam Average thickness 6 feet 6 inches (1.97 m.)	Lower seam Average thickness 7 feet 6 inches (2.28 m.)
	Raw	Raw	Raw
Moisture in sample as received in laboratory	% 0.9	% 0.7	% 0.7
Proximate analysis of coal, dried at 105°C.—			
Fixed carbon	58.0	54.1	56.0
Volatile matter	25.0	26.7	27.8
Ash	17.0	19.2	16.2
Ultimate analysis of dried coal—			
Carbon	69.8	....	71.1
Hydrogen	4.0	....	4.3
Sulphur	0.5	0.5	0.5
Nitrogen	0.8	0.9	0.7
Oxygen	7.9	....	7.2
Ash	17.0	....	16.2
Calorific value of dried coal by determination	Calories 6,700	6,310	6,790
Calorific value of dried coal by determination	B.T.U. 12,060	11,360	12,230

Coking tests of these coals, made for the Mines Branch of the Department of Mines, showed that only the coal of the lower seam produced a coke of commercial value.

Summarized, the results of the tests were:—

	Yield	Quality
Upper seam, raw	75.9%	Not a commercial coke; grey in colour, dense but crumbling, and without regular fracture.
Upper seam, washed	75.3	A poor commercial coke; similar to that from the raw coal, though sounder.
Middle seam, raw	75.8	Not a commercial coke; similar to the product from the raw coal of the upper seam.
Middle seam, washed	77.4	Possibly a commercial coke; not as good as that from the washed coal of the upper seam.
Lower seam, raw	74.6	A very fair commercial coke; probably suitable for blast furnace fuel.
Lower seam, washed	74.1	A commercial coke; harder and sounder than that from the raw coal.

The coal production in Yukon has been small, partly because there has been little demand for coal, up to the present, and partly because only a few of the deposits are conveniently situated for shipping purposes. The production for the past three years in metric tons was, approximately:—

1910	11,800
1911	12,200
1912	8,600

The following table gives the probable amount of coal in Yukon in seams 1 foot (0.30m.) or over in thickness :—

SUMMARY OF COAL RESOURCES OF YUKON

Field	Area, sq. miles	Class of coal	Age	Metric tons
Whitehorse area	300	A_2	Jura-Cretaceous	40,000,000
Tantalus area	690	B_2	Jura-Cretaceous	70,000,000
		B_3	Jura-Cretaceous	80,000,000
Braeburn-Kynocks area	310	B_3	Jura-Cretaceous	50,000,000
Selkirk area	100	B_3	Jura-Cretaceous	10,000,000
Belly river areas		B_3	Jura-Cretaceous	
Arctic area		B_3 to D_1 (?)		
Rock creek area	600	D_1	Tertiary	3,000,000,000
Kluane district	20	D_1	Tertiary	40,000,000
Bonnet Plume area	400	D_2	Tertiary	1,500,000,000
Indian river area	150	D_2	Tertiary	150,000,000
Old Crow basin	120	D_2	Tertiary	
Francis and Liard river basins	150	D_2	Tertiary	
Totals	2,840			4,940,000,000

Summary of Estimate of Coal Resources of Canada

The following tables contain summarized estimates of the coal resources of Canada.

GROUP I.

Including Seams of 1 Foot and Over, to a Depth of 4,000 Feet

District	Actual reserve (Calculation based on actual thickness and extent)			Probable reserves (Approximate estimate)		
	Area, square miles	Class of coal	Metric tons	Area, square miles	Class of coal	Metric tons
Nova Scotia	174.31	B_2	2,137,736,000	273.5	B_2	4,871,817,000
		C	50,415,000	.....	C	20,000,000
New Brunswick	.....	.....	.....	121.0	B_2	151,000,000
Ontario	.....	.....	.....	10.0	D_2	25,000,000
Manitoba	.....	.....	.....	48.0	D_2	160,000,000
Saskatchewan	306.0	D_2	2,412,000,000	13,100.0	D_2	57,400,000,000
Alberta	25,300.0	D_2	.....	56,375.0	D_2	26,450,000,000
		D_1	382,500,000,000		D_1	464,821,000,000
		B_3	1,197,000,000		B_3	139,161,000,000
		B_2 B_1	2,026,800,000		B_2 B_1	43,022,600,000
		A_2	669,000,000		A_2	100,000,000
		A_2 B_2	23,653,242,000		A_2 B_2	40,807,700,000
British Columbia	439.0	B_3	118,000,000	5,595.0	B_3	2,300,000,000
		D_2	60,000,000		D_1 D_2	5,136,000,000
					C	1,800,000,000
Yukon	.....	.....	.....	2,840.0	A_2 B_3	250,000,000
					D_1 D_2	4,690,000,000
North-West Territories	.....	.....	.....	300.0	D_2	4,800,000,000
Arctic islands	.....	.....	.....	6,000.0	B_2 B_3 C	6,000,000,000
Totals	26,219.31	.....	414,804,193,000 *	82,662.5	.....	801,966,117,000

* In this total 20,000,000 has been deducted for the amount of coal of all classes already extracted in Alberta.

GROUP II.

Including Seams of 2 Feet and Over at Depths Between 4,000 and 6,000 Feet

District	Probable reserves (approximate extimate)		
	Area, sq. miles	Class of coal	Metric tons
Nova Scotia (marine areas, 3 to 5 mile limit)	73	B_2	2,639,000,000
Alberta	203	B_2	12,700,000,000
British Columbia	11	B_2	2,160,000,000
Totals	287	.....	17,499,000,000

TOTALS BY PROVINCES—GROUPS I AND II..

	Metric tons
Nova Scotia	9,718,968,000
New Brunswick	151,000,000
Ontario	25,000,000
Manitoba	160,000,000
Saskatchewan	59,812,000,000
Alberta	1,072,627,400,000
British Columbia	76,034,942,000
Yukon	4,940,000,000
North-West Territories	4,800,000,000
Arctic islands	6,000,000,000
	1,234,269,310,000

The coal reserve of the various portions of the Empire are given in the following table.

	Anthracite coals	Bituminous coals	Sub-bituminous coals, brown-coals and lignites	Totals
	Million tons	Million tons	Million tons	Million tons
Canada	2,158	283,661	948,450	1,234,269
Great Britain and Ireland	11,359	178,176	.....	189,533
Australia	659	132,250	32,663	165,572
India	.....	76,399	2,602	79,001
South Africa	11,660	44,540	.....	56,200
New Zealand	.....	911	2,475	3,386
Rhodesia	2	493	74	569
Newfoundland	.....	500	.....	500
Southern Nigeria	.....	.....	80	80
British N. Borneo	.....	75	.....	75
	25,838	717,005	986,344	1,729,185

CHAPTER IX.

RADIUM-BEARING MINERALS

A VALUABLE handbook has recently been issued by the Department of Mines containing "Notes on Radium-Bearing Minerals." In describing Canadian occurrences it is pointed out that radium-bearing minerals have not been found in economical quantities in Canada, but traces of such minerals, or small quantities, have been discovered in certain parts of Ontario and Quebec. As radium is found associated with uranium, the following notes in the Prospector's Handbook No. 1, Geological Survey, Canada, may be of much interest to prospectors in the Yukon:

Uranium Minerals

"A great variety of uranium minerals have been recognized, but the most of them are of rare occurrence. Those that occur chiefly in commercial quantities are pitchblende or uraninite, carnotite, and autunite.

"Pitchblende carries a much higher percentage of uranium than either of the other two, and is a uranate of uranyl, lead, usually thorium (or zirconium) and, often, the metals of the lanthanum and yttrium groups; it also contains nitrogen in varying amounts up to 2.6 per cent. It is brittle, has a conchoidal or shell-like fracture, is of sub-metallic to greasy, pitch-like or dull lustre, is opaque, and in colour is greyish, greenish, brownish, and velvet black. Its hardness is 5.5; that is, it is nearly as hard as feldspar. The specific gravity of crystals, which are rare, is 9 to 9.7. In the massive state its specific gravity is 6.4; that is, it is between two and three times as heavy as a piece of quartz, limestone, or granite of equal size. The greasy or pitch-like lustre and the high specific gravity are striking features of this mineral.

Carnotite is a mineral varying somewhat in composition and containing vanadium and uranium, with either or both lime and potash. It is a canary-yellow, and powdery or waxy-looking mineral. "With a hand lens it can in places be seen to have a somewhat radial but rather indefinite crystal form. Very rarely it takes a solid form, which cuts like paraffin and has an unctuous feel. In the powdery form the colour may be somewhat disguised by iron oxide or calcium vanadate." [1]

Autunite is a phosphate of uranium and calcium. It is translucent, bright yellow in colour, and occurs in small plates or tabular crystals or in micaceous aggregates.

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[1] Hess, Frank L.: Uranium and Vanadium. U.S. Geol. Survey, Mineral Resources, Pt. 1, Metals 1912, pp. 1003-1037. Prospector's Handbook No. 1. No. 1368, Geological Survey, by Wyatt Malcolm.

Chalcolite or torbernite is a hydrous phosphate of uranium and copper. It occurs in square tabular crystals, thin or thick; it is found also in foliated and micaceous aggregates. It has a pearly to subadamantine lustre, and is transparent to translucent. It is emerald green and grass green, some specimens being apple or siskin green. Hardness 2 to 2.5; specific gravity, 3.4 to 3.6."

After describing some of the most important occurrences of uranium minerals, the Prospector's Handbook contains the following conclusions:—

"An examination of the descriptions of the occurrences of uranium or radium-containing ores shows that they are nearly all associated with igneous rocks of an acid character such as granites, pegmatite dykes, and quartz porphyry dykes. They are found enclosed within the body of pegmatite dykes or in veins cutting granite, or schists or slates intruded by granite or porphyry dykes, and probably have their origin in solutions given off by these igneous rocks at or about the time of intrusion.

These minerals have a great variety of mineral associations. In Colorado they are associated with pyrite and small quantities of galena and zinc blende, in Joachimsthal with silver, cobalt, and nickel ores, in Portugal with tin and tungsten minerals, and in Cornwall they are found in the tin and copper mining district.

The carnotite deposits of Utah and Colorado constitute an exception to the usual mode of occurrence. Here the uranium-vanadium mineral carnotite occurs with other vanadium minerals as an impregnation in sandstone beds and in cavities and cracks in the sandstone and in fossils.

The great variety of mineral associations of uranium makes it advisable that the prospector should not neglect a careful search for its presence in all known mineral deposits, especially those that are genetically related to intrusions of granite and closely allied rocks. Localities where traces of tin and tungsten minerals are found should receive attention. The silver-cobalt-nickel deposits of Cobalt resemble very closely those of Joachimsthal, but the occurrence of pitchblende has not been reported.[1]

Pegmatite dykes should be examined. These are particularly abundant in the Pre-Cambrian area of eastern Ontario and western Quebec. These dykes are composed chiefly of quartz and feldspar and are usually very coarse grained so much so that large fragments of either of the two minerals can be readily separated from the mass. It is from these dykes that feldspar produced in Ontario and Quebec is obtained. In similar rocks a great number of rare minerals and of gem stones are found.

Powdery and crystalline minerals of a bright yellow to emerald green colour, and heavy minerals of a dull or greasy lustre should be tested. In the search for radium-bearing minerals the prospector should keep in mind the possibility of discovering others of economic importance. Any mineral of striking appear-

[1] Miller, W. G.: The cobalt-nickel arsenides and silver deposits of Temiskaming. Report of the Bureau of Mines (Ontario), vol. 19, part 2, p. 10, 1913.

Prospector's Handbook No. 1. No. 1368, Geological Survey, by Wyatt Malcolm.

ance, especially one that is considerably heavier than a piece of quartz or feldspar of equal size is worthy of examination."

Quartz prospectors should particularly note that radium-bearing ores are nearly all associated with igneous rocks of an acid character, such as granites, pegmatite dykes, and quartz porphyry dykes, and that pegmatite dykes should be carefully examined. Valuable reports have been issued from time to time by the Geological Survey Branch, of the Department of Mines, and these reports should be carefully read by prospectors who desire to secure accurate knowledge concerning the rocks with which radium-containing ores are associated. For instance, in describing the rocks along the Yukon river, between Sixty-mile and the mouth of the Stewart river, Mr. McConnell observes:

"Numerous veins of coarse pegmatite, quartz and less frequently calcite, cut the beds in all directions, and are present in nearly every section."

In describing the character of the rocks along the Yukon, above the mouth of White river, the same authority states:—

"Quartz veins occur less frequently as we ascend, and are replaced by veins of coarse pegmatite. Igneous rocks are almost absent in the lower part of this reach, but coarse granites and diorites were met with about twenty-five miles below the mouth of the Pelly."

As radium-containing ores are also found enclosed in veins cutting granite, or schists or slates intruded by granite or porphyry dykes, the following extracts from the "Report on the Klondike Gold Fields" by R. G. McConnell, B.A., concerning igneous rocks and quartz porphyries are of considerable interest:

Granite

"Granite occurs on the Yukon river about three miles below the mouth of Indian river. The area has a width, where cut by Yukon river, of less than two miles, but widens out towards the east. The boundaries of the area as shown on the map are only approximate, as its contact with the surrounding schists is seldom seen. Good exposures occur on the right bank of the Yukon, but the area narrows crossing the valley, and is only found at one point on the left bank.

The granite in this area is grayish in colour when fresh, and coarsely granular in texture as a rule, although in places it becomes distinctly porphyritic. It is usually unfoliated but is slightly sheared in places. Microscopically, it consists essentially of quartz, orthoclase, plagioclase (mostly oligoclase,) bleached biotite, and some hornblende, mostly altered into chlorite. The feldspars are usually decomposed and include scales and grains of sericite, and calcite. Almandine garnet is a frequent accessory mineral.

Quartz Porphyries

The quartz porphyries are the youngest igneous rocks in the district. They occur in numerous, small, oblong areas, everywhere throughout the region, both in the valleys and on the ridges. The areas usually measure from one to two

hundred yards in width and from a quarter to half a mile in length, and might be classed in most cases as wide, short dykes. They were found to be intrusive through the schists and older rocks in all cases where contact exposures were available for study.

The quartz porphyry, microscopically, is a pale yellow compact rock sprinkled with small phenocrysts of dark quartz and yellowish decomposed feldspar. In thin sections it shows a microgranitic ground mass through which individuals of quartz, orthoclase and plagioclase are porphyritically distributed. Quartz is the most abundant porphyritic mineral, and occurs both in rounded and corroded forms and in perfect dihexehedral crystals. The feldspars usually exhibit good crystallographic outlines.

The various dykes and areas of the recent acid volcanic rocks dotted over the district agree, as a rule, very closely in character, but in a few cases the microgranitic ground mass is replaced by a glassy base, and the rock might be classed as a rhyolite rather than as a quartz porphyry. A specimen from a small area, probably effusive in character, situated on the right bank of the Klondike river, seven miles above Rock creek, showed, in thin sections, a glassy ground mass with fluidal structure, holding microlites and spherulites of quartz and feldspar. The porphyritic individuals, in addition to those in the quartz porphyrys, included occasional scales and plates of brown biotite."

Igneous Rocks

The igneous rocks in the Pelly district are described by Mr. Keele as follows:

"The unaltered igneous rocks appear in this region only as small isolated masses among the sedimentary or metamorphic rocks.

Granite was seen about ten miles up the Ross river, where it forms a ridge about 1,800 feet high on the north side of the river.

The rock is a fine-grained, brownish coloured, biotite granite, and is intrusive in the crystalline schists which are seen exposed around the base of the ridge.

This granite is different to the bodies which sometimes form the centre of the mountains in the sedimentary rocks, being finer grained and of a more acid type. It has been exposed to erosive influences for a long period, and the profile of the ridge is similar to adjacent ones composed wholly of sedimentary rocks.

Several important bodies of igneous rocks occur as stocks, or cores, in the higher mountains, or mountain groups. Mount Sheldon, overloooking the lake of that name on the Ross river, is so formed.

The rock here is a granite porphyry, of exceedingly coarse grain, in the form of a pillar, which has eaten its way up through the Palæozoic sediments.

The contact is well defined; the granite has merely baked, and rendered brittle the argillites enclosing it.

The granite is well jointed, and weathers into a serrated crest, the argillites being worn away for a distance of several hundred feet below the summit.

As the granite stocks or pillars become unroofed they offer greater resistance to weathering than the mountains composed entirely of sedimentary rocks, hence the mountains possessing granite centres persist longer at high elevations, and are also more conspicuous by reason of their bolder outlines and more rugged crests.

Itsi mountain and Mount Wilson are of this character, and several mountains on the Macmillan and Stewart rivers, which are prominent topographic features, were found to be built of granite.

On the banks of the Ross river between Big Timber creek and the first rapid are a few isolated exposures of granodiorite and rhyolite, both bedded and massive but the relation of these bodies to the sedimentary rocks and to each other was not seen.

On Pelly river below Slate rapid are a few outcrops of diabase, intrusive in slates and quartzites. This rock is fine grained and much altered, is traversed by veinlets of quartz and calcite, and becomes slightly schistose at the margins.

Large boulders and blocks of similar rock were seen on the lower part of the Ross river, but were not found in place in that locality."

In describing the coast granites, Mr. D. D. Cairnes in his "Report on a Portion of Conrad and Whitehorse Mining Districts, Yukon" observes that:

"The granites that outcrop along Lake Bennett near Caribou Crossing, and cut the Mt. Gray ridge, are generally cross-grained and hornblendic, containing, at times, black mica, and are in all probability of the same age as the granites to the west. Wherever these granites could be found in contact with the porphyrites of the Windy Arm series, dikes of the porphyrites were seen cutting the granites."

In his report of the "Yukon-Alaska International Boundary, between Porcupine and Yukon Rivers," Mr. Cairnes makes the following observations on the igneous rocks in that district:

"The igneous rocks of this belt are divisible into two main groups. One group is composed of somewhat basic intrusives dominantly diabases, diorites, andesites, and related types; the other group is somewhat more acidic and includes mainly plutonic intrusives of granitic habit, which range in character from granites to gabbros.

The members of the granitic group outcrop in only four or five localities and at each point the exposures are small. The largest area of these rocks occurs along the left limit or west side of the Yukon within about 3 miles of the crossing of this river by the Boundary line. There these rocks appear to constitute a small boss with a diameter of from one-quarter to one-half a mile. The only other exposure of these rocks within this Boundary belt, sufficiently large to be shown on the accompanying map, occurs on the west side of Racquet creek. This exposure much resembles that along the Yukon, but is possibly somewhat

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A reconnaissance across the Mackenzie mountains on the Pelly, Ross and Gravel rivers, Yukon and North-West Territories (No. 1097), by Joseph Keele.

Report on a Portion of Conrad and Whitehorse Mining districts, Yukon (No. 982), by D. D. Cairnes.

The Yukon-Alaska International Boundary between Porcupine and Yukon rivers, Memoir No. 67 (No. 1461), by D. D. Cairnes.

smaller in extent. All these granitic rocks where noted cut the members of the Yukon or Tindir groups and are thus only known to be more recent than these rocks. However, since they are lithologically very similar to the Coast Range intrusives[1] which are extensively developed in Yukon and British Columbia, and were intruded in Mesozoic time, it is considered quite possible that these granitic rocks along the Boundary are also of this age.

The members of the more basic group occurring within the Boundary belt for approximately 145 miles south of the Porcupine or to a point between Ettrain and Tindir creeks, include diorites, andesites, and diabases, which occur as dykes and small irregular intrusive masses, but have a very insignificant areal development. In fact, the exposures of these rocks within this portion of the Boundary belt are all too small to be shown on the accompanying geological map, except a dyke which occurs just north of Bern creek and which does not appear to exceed 150 feet in width, and also three small developments in the vicinity of Porcupine river, none of which are more than 1500 feet in their greatest surface dimension.

Commencing about 3 miles north of Tindir creek, however, these intrusives become extensively developed, particularly in association with the sedimentary members of the Tindir group, and thence to Yukon river, a distance of about 45 miles, not only have they invaded Tindir sediments but in addition they have intruded the members of the Yukon group, as well in places as the lower beds of the Devono-Cambrian limestone-dolomite terrane. Throughout this more southerly 45 miles section of the Boundary belt here under consideration, however, all these intrusives that were examined proved to be diabases, although it is quite probable that other related types occur. These intrusives constitute here one of the most prominent members of the Tindir group and occur as dykes, sills, and irregular intrusive masses. Since, however, these diabases and related rocks are so extensively developed in association with the members of the Tindir and Yukon groups and only rarely cut the more recent rocks, it seems evident that although they are all lithologically very similar, and range in age from Pre-Cambrian (?) to possibly about Devonian, they must nevertheless be dominantly of pre-Middle Cambrian age. The diabases are prevailingly greyish to dark green, fine to medium textured rocks which possess an ophitic structure, and may or may not be amygdaloidal in character. When amygdaloidal, however, the amygdules are dominantly filled with secondary minerals mainly quartz, calcite, zeolites, or chlorite. On weathered surfaces these intrusives are characteristically reddish to reddish brown, due to the oxidation of the iron-ore minerals which they contain and which in some of these rocks are somewhat abundantly distributed or peppered through the rock mass.

Tests

An electroscope is useful in making tests for radium, but it cannot always be carried about conveniently. The scintilloscope is a much more convenient

[1] Cairnes, D.D., " Atlin Mining district, British Columbia ": Geol. Surv., Can., Memoir No. 37, 1913, pp. 57-59.
" Upper White river district, Yukon ": Geol. Surv., Can., Memoir No. 50. In press. See section on " Granitic intrusives."

instrument. It should, however, be carefully tested with a mineral known to be radioactive before taking it to the field; its usefulness may be lost by careless handling.

An electroscope is a metal box, through an opening in the top of which a metal strip is suspended by means of a bit of sulphur or amber so that it is insulated from the box. Resting against the metal strip and attached to it by its upper end is a strip of gold leaf. When the metal strip and gold leaf are charged with electricity the latter diverges from the former at an angle. The divergence can be viewed through an opening in the side of the box. The electroscope discharges slowly under ordinary conditions and the gold leaf returns to its original position. The rate of discharge is hastened by bringing a radium-bearing mineral near the instrument. It is a delicate instrument and requires some skill in manipulation.

The scintilloscope consists of a closed brass cylinder, provided at one end with a lens and coated interiorly with zinc sulphide. A radium-bearing mineral brought close to this instrument produces scintillations in the zinc sulphide that can be viewed through the lens in a dark room. This instrument can be had for a dollar or two from Gallenkamp & Co., 19-21 Sun Street, Finsbury Square, London, E.C., England.

If uranium is present in quantities likely to be commercial it can be detected by the radioactivity of its decomposition products by laying the suspected specimen upon a plate holder containing a sensitive photographic plate and leaving it from twelve hours to one week. If uranium is present in any considerable quantity the plate will be light-struck. It is well to note, however, that minerals containing thorium produce the same effect upon a photographic plate.

The presence of carnotite is indicated by a yellow colour brought out in a specimen when it is heated, as by laying it on the top of a stove.

All the above tests require more or less skill and experience in their application and it is always advisable for the inexperienced person to submit a suspected specimen to an expert for examination."

It was recently announced that the production of radium from Colorado carnotite ores by the U. S. Bureau of Mines in connection with the National Radium Institute had reached a successful manufacturing basis. The following extracts are from a copy of a statement issued on the 27th of July, 1915 by the U. S. Secretary of the Interior in regard to the production of radium from carnotite ores:—

". . . The cost of one gram of radium metal produced in the form of bromide during March, April and May of the present year was $36,050, I am informed by Dr. Charles L. Parsons, in charge of the radium investigations of the bureau. This includes the cost of ore, insurance, repairs, amortization allowance for the plant and equipment, cost of Bureau of Mines co-operation, and all expenses incident to the production of high grade radium bromide. When you consider that radium has been selling for $120,000 and $160,000 a

gram, you will see just what the Bureau of Mines has accomplished along these lines. . . .

". . . The demand for radium will also increase rapidly, for the two or three surgeons who have a sufficient amount of this element to entitle them to speak from experience are obtaining results in the cure of cancer that are increasingly encouraging as their knowledge of its application improves. A few more reports like that presented to the American Medical Association at its recent San Francisco meeting and the medical profession as a whole will be convinced of its efficacy. . . .

". . . The ten carnotite claims being operated at Long Park, Colorado, by the National Radium Institute have already produced over 796 tons of ore averaging above two per cent uranium oxide. The cost of ore delivered at the radium plant in Denver has averaged $81.30 per ton. This included 15% royalty, salary of Bureau of Mines employees, amortization of camp and equipment and all expenses incident to the mining, transportation, grinding and sampling of the ore.

" A concentrating plant for low grade ores has been erected at the mines and is successfully recovering material formerly wasted. Grinding and sampling machinery has been installed at Denver and a radium extraction plant erected in the same city. The radium plant has now a capacity of three tons of ore per day, having been more than doubled in size. Previously the plant had been run more or less on an experimental scale although regularly producing radium since June, 1914. To July 1, slightly over three grams of radium metal had been obtained in the form of radium barium sulfate containing over one milligram of radium to the kilogram of sulfates. The conversion of the sulfates into chlorides and the purification of the radium therefrom is easily accomplished and with very small loss of material. Unfortunately, however, special acid proof enamel ware, obtainable only in France, has not been delivered of sufficient capacity to handle the crystallization of the full plant production, so that a little less than half the output, or to be exact, 1304 milligrams of radium element have been delivered to the two hospitals connected with the National Radium Institute. The radium remaining can be crystallized at any time from neutral solution in apparatus already installed, but the greater rapidity and efficiency of production of this very valuable material by the methods used have decided the Bureau of Mines to await the completion of apparatus now being built before pushing the chloride crystallization to full capacity.

" The average radium extraction of all ore mined by the National Radium Institute has been over 85 per cent of the amount present in the ore as determined by actual measurement. The amount present in the ore has been found in fact to be essentially the same as the theoretical amount required by the uranium-radium ratio. The extraction figures for the last five carloads of carnotite treated has shown a recovery of over 90 per cent in each case."

CHAPTER X.

FOX FARMING

THE Yukon was first explored by the officers of The Hudson's Bay Company, in pursuance of the fur trade, and there are still trappers in the more remote districts of the territory. The day of the trapper, however, is passing, chiefly by reason of the decrease in the supply of fur of good quality. In addition, numerous valuable fur bearing animals are destroyed by carnivorous mammals, before the trapper can inspect his traps, and the killing of animals, whose pelts are not in prime condition, constitute a large annual loss of valuable fur. These conditions can be eliminated when fur bearers are domesticated, and as a result fox farming is rapidly developing, particularly in the southern part of the Territory.

During the year 1913 over three hundred live silver, black and cross foxes were exported from the Territory, but in March, 1914, legislation was enacted by the Yukon Council prohibiting the exportation of live foxes except under

Polar fox (white) ranched in Russia. This animal is of the same species as the blue fox which is ranched in Alaska and Canada. The fox is in summer coat. "Fur-Farming in Canada," 1914

certain conditions. In consequence of this legislation four Limited Liability Companies have been formed, and between fifteen and twenty privately owned ranches are now in operation. It is estimated that the total value of foxes held in captivity on the 1st of January, 1915, was $175,000.00, which does not include the increase for 1915.

The following is a list of fox and mink farms in the southern part of the Yukon:—

Names	Location	Black and silvers	Cross foxes	Mink
A. R. Austin	Tagish lake, Y.T.	5	22	..
E. J. Proulx	Carcross, Y.T.	4	6	..
Faulk Fox Farm	Carcross, Y.T.	5	25	..
Charles Ennis	Marsh lake, Y.T.	..	6	..
Colwell Fur Farms, Limited	Whitehorse, Y.T.	8	24	..
J. P. Whitney Black Silver Fox Co., Ltd	Whitehorse, Y.T.	16	13	..
Whitehorse Black Silver Fox Co.	Whitehorse, Y.T.	5	9	..
Harry Chambers	Champagne Landing, Y.T.	6	21	..
M. E. Bones	Klaune Lake, Y.T.	2	48	..
Frank Back	Carmacks, Y.T.	1	10	..
Taylor & Co.	Carmacks, Y.T.	4	10	..
Jas. Boss	Lake Lebarge, Y.T.	3	12	..
J. R. Alguire	Whitehorse, Y.T.	4	10	..
McDade & Neilson	Carmacks, Y.T.	..	8	..
S. E. Chambers	Carcross, Y.T.	..	4	..
Wright Wenrich	Whitehorse, N.Y.	1	17	..
Leo Simmons	Carcross, Y.T.	..	2	20
Brown, Scott & McGlashan	Tagish Lake, Y.T.	..	..	40
Oscar Burbank	Jarvis River, N.Y.	..	..	25
Brewer & Geary	Hootalinqua River, Y.T.	..	2	40
		64	249	125

" Fox Farming in Canada " contains the following summary of the best conditions for fox ranching operations:—

1. Foxes should be ranched in woodland areas with good drainage in a climate cold enough to produce a heavy fur and overhair and which is cool in summer.

2. The value of the pelt depends on good health as well as on climatic conditions. Wholesome, varied food is a necessary condition for health and can be best secured in a thickly-settled rural district.

3. Foundation stock should be the best obtainable. The best foxes are those in captivity in ranches, and they have the additional advantage of being half-domesticated.

There are some advantages to be gained by conducting extensive ranching operations in one locality, particularly because breeding animals may be easily exchanged and the dangers of close, or in-breeding, prevented. Neighbours can also impart to one another more freely what their experience has taught them.

Fox Farming in Canada, by I. Walter Jones. Published by Commission of Conservation, Canada.

These advantages, however, may be offset by the difficulties of securing food for the foxes. In every rural township there is enough cheap meat and offal to supply flesh diet to scores of foxes, but not to hundreds. Several hundred foxes, therefore in one neighbourhood, would necessitate the purchase of costly meat. An ordinary farm has enough waste meat scrap, dripping, bread, biscuits and game to support several animals.

A Woodland Site.—A wooded area, not subject to flooding, and where the snow does not pile up in deep drifts in winter, is best adapted for the site of the ranch. The subsoil should be a hardpan to prevent deep burrowing and escape under the fences. Areas which produce a growth of birch, spruce, fir and cedar, with heath plants and blueberries in the open areas, have usually a good turfy cover and a hardpan subsoil near the surface. In such a situation it is easy to erect pens as the fences have only to be extended down to hardpan to prevent the foxes from burrowing under and escaping. A sandy soil and subsoil, on the other hand, while providing good drainage, entails an additional expense, as foxes can burrow to depths of six feet or more. A family of foxes working one behind the other will relay earth out of a sandy hole in a veritable shower. In ordinary loam, the fence is not considered safe unless it extends down a depth of over three feet or is founded on a subsoil of considerable hardness.

Proximity to the dwelling of the keeper is also an important consideration. This is usually accomplished by building the ranch in a woodland lot a few hundred yards distant from the house, or, if the ranch is a considerable distance from the owner's dwelling, by building a house for the keeper. It is not advisable to keep fox pens nearer than ten rods to a dwelling as, particularly during muggy weather, the peculiar and somewhat disagreeable 'foxy' smell is strong and unpleasant.

The advantages of a large woodland ranch may be summed up as follows:—

1. The outer fence and bush cover protect the foxes from curious sightseers, dogs, cattle and thieves, and give them a sense of being hidden from enemies.

2. The bush cover is especially valuable for nervous foxes to hide in and to provide shade for the fur. They will also sleep contentedly all day under a bush, where it is more healthful than in a nest or a burrow.

3. The outer fence is an additional insurance against escape to the woods. If a fox escapes from the paddock, he can be easily caught in the outer enclosure, or, if the door is left open, he may, of his own accord, go back to his pen at feeding time.

4. The snow does not pile in drifts, but lies level, on wooded areas. Huge drifts necessitate higher fences, or wiring over, to prevent escape. Fences do not need to be more than six or seven feet high if the snow never lies more than one or two feet deep.

5. A ranch in the woods has more equable climatic conditions. It is cooler in summer, less windy in winter, and is warmer for young foxes in the spring. There is less thawing and freezing up of snow to injure the fur. It also affords protection from rain and sleet.

6. The foxes can hide from thieves and could not be captured by a stranger unless the house were broken into when they were shut in their nest. So much noise, however, would be sure to rouse the dog and the watchman.

7. The outer enclosure permits of protective measures being taken. The keeper sleeps in a house there. Dogs are kept chained. Traps for thieves are laid, as, *e.g.*, bear traps, burglar alarms, electric shocking devices; and some ranches are lighted with lanterns or electric lights and are equipped with telephones.

8. Large ranches seem to be more successful than smaller ones, because foxes in contiguous pens are company for each other."

The fur of these seven months' old pups is in prime condition and almost as valuable as that of maturer animals

The following particulars will also be of value to those who are interested in judging a silver fox skin:—

The condition of the pelt in respect to primeness, proper killing, skinning drying and shipping is important. Skins may be blue or unprime; springy, when the hips and shoulders are worn and the hair loose; dirty, shot, chewed, heated, or greasy. In such cases their value is largely decreased.

The skin value of the live animal may be judged from the following standards:

Colour.—Glossy black on neck, and wherever no silver hairs are found. The black must be of a bluish cast all over the body rather than a reddish. The underfur must also be dark-coloured. The fur of silver and black foxes is a dark slate next to the skin.

Silver hairs.—Pure silver bands—not white nor very prominent. In the costliest skins there are only a few silver hairs, which are well scattered over the pelt. Flakiness, which is the appearance of whitish silver hairs placed close together in patches, is objectionable.

Texture.—Buyers pass judgment on the skins by drawing the hand over the fur. The softest fur is the most valuable. The quality of softness is referred to as " silkiness ".

Gloss.—The sheen must be evident. It is caused by the perfect health of the animal and the fineness of the hair, as well as by hereditary

A red fox of Russia. "Fur-Farming in Canada," 1914. (Courtesy of V. Generosoff.)

influences. Woods and humid atmosphere also favour this important quality.

Weight.—A good fox skin will weigh at least one pound, the weight usually varying from ten to nineteen ounces. The thick, long fur makes the weight. This is a very important point, as heavy fur is more durable and handsome.

Size.—The value of silver fox pelts increases with the size.

In discussing the classification and colour phases of the common red fox Mr. J. Walter Jones in " Fox Farming in Canada " makes the following observations:—

The common red fox, which exists in the greatest numbers, has a range which " extends across Europe and northern and central Asia to Japan, while, to the

south, it embraces northern Africa and Arabia, Persia, Baluchistan and the northwestern districts of India and the Himalayas." In North America, its range extends south to Virginia and includes all Canada (except some northern regions), and the northeasternmost portion of the United States. Its wide geographical range accounts for many distinct local phases or geographical varieties. These phases, or sub-species, differ from one another in form, in size and, to some extent, in colouring; but the differences are often not apparent to the untrained observer. It is easy to distinguish the four species of foxes commonly seen in America, viz., the common red with its white tipped tail, the arctic or polar fox with its short ears and blue or white pelt, the kit-fox with its black tail and small size, and the gray fox with its gray and red colour and erectile hairs down the tail; but it is more difficult to distinguish the sub-species of the common red fox.

The popular classification is by colour, as follows:—

Common Red Fox (*Vulpes*), found in some districts in several colours, viz.:

Red fox—When red or yellow over sides and back.

Silver fox—When no red is present.

Cross or patch fox—When the sides and neck are red and the back, shoulders and hips are silver. An intermediate between silver and red.

The red, silver and cross foxes are not distinct species and not even distinct breeds. Silver foxes usually breed true to colour, and continued selection will insure the distinctive colour markings of each colour variety.

Scientists, of course, follow the universal rule of measuring the skulls and teeth for classification purposes. The colour is not a consideration with them. Merriam classified the North American red foxes as follows:—

V. fulvus—Ontario, Quebec, Eastern United States.
V. bangsi—Labrador and North shore of gulf of St. Lawrence.
V. deletrix—Newfoundland.
V. rubricosa—Nova Scotia, New Brunswick, Gaspe, Prince Edward Island.
V. regalis—Manitoba, Dakota, Montana, Alberta.
V. macrourus—Wyoming, Nevada.
V. abietorum—British Columbia, Alberta, North-West Territories.
V. alascensis—Alaska, Yukon.
V. harrimani—Kadiak islands.
V. kenaiensis—Kenai peninsula.
V. cascadensis—Washington, Oregon, California.
V. mecator—California.

Investigation of the debated question of the colour phases of foxes has produced definite information regarding its occurrence. The fact that the cross, silver, black and red colours are all colour phases of the common red fox is of too common knowledge to warrant citing of the many cases examined for evidence. The colours all exist and why they exist may be left to the discussion of biologists, some of whom say that ages ago foxes were originally dark coloured and that the silver is atavistic. It will be more useful in this discussion to describe how the costlier, darker colour is produced from cheaper, red parents.

A summary of the facts may be given as follows:—

1. Silver parents always produce silver pups—never red or cross pups.

2. Red parents mostly produce red, but, occasionally, some cross or patch pups and even a small proportion of silver pups is produced.

3. Usually cross or patch parents produce cross or patch pups.

4. When a silver and a pure red are bred, they produce red pups with blacker markings on the belly, neck and points than the red parent. The pups are about of the colour known to furriers as ' bastard.'

5. When a bastard red fox and a silver are mated often the litter is on the average of 50 per cent silver and 50 per cent red.

6. Bastard red parents often produce a black or silver pup in a litter—the proportion of silver being about one out of four.

7. The exceptions to the above rules are that sometimes the colours do not segregate, but rather blend, as in roan cattle when red and white hairs are intermixed and not separated into distinct patches. Cross foxes are produced by mating a red and a silver and, sometimes, an intermediate colour is secured in the pups. Thus, in some districts, every combination of the red, white and black colours of foxes is found. There are foxes which are:

Red	*Red.*—Red above and white below, with dark points.
	Bastard.—Red above and dark below and on the neck, with darker points.
Cross or Patch	*Poor Cross.*—Mostly red and dark as above with a silver patch down the back and over the shoulders and hips.
	Good Cross or *Rusty Silver.*—Slightly red on the sides, neck and ears, dark below and silvery over the back, shoulders and rump.
Silver	*Silver* or *Light Silver.*—Silvery all over, except possibly the neck; dark below and white only on the tip of the tail.
	Silver Black or *Dark Silver.*—Black all over, except the tip of the tail and the silvery hairs on the hips and forehead.
	Black.—Pure black all over, except the tip of the tail, with, perhaps, dark silvery hairs only discernible on close examination.

No two foxes are exactly alike in colour unless they be black. Three silver foxes examined had no white tips on their tails and others had only a half dozen white hairs—yet the white tip is one of the marks of identification for the species. Others had white patches on the legs or breast, while the rest of the colouring was almost pure black.

A silver fox when mated with a pure red usually produces silver pups in two crosses. If the first cross produces all red pups, two methods of breeding may be adopted:

(a) A male and a female pup may be crossbred, producing, on the average, one silver pup to three reds.

(b) A red pup may be bred to the silver parent, producing on the average, 50 per cent red pups.

It is a more unusual occurrence to secure a blend or intermediate colour from crossing a silver and a red. By breeding the pups for four generations to a silver the red colour is eliminated from the pelage markage. The segregation of the red and silver colour appears to be very common in many localities, but, in others the roan or intermediate form of colour is produced quite frequently, the parent characters blending and the hybrid usually breeding true.

In this connection it will be of interest to quote from a letter dated August 2, 1912, received from Professor W. Bateson of Cambridge University, England, a naturalist of high repute and an authority on hair pigmentation. In the early stages of the investigation the usual opinion of naturalists and breeders was accepted and it was thus stated to Professor Bateson that silver parent foxes would produce an occasional red pup. This popular opinion has since been found to be usually incorrect. Professor Bateson's opinion has, therefore, been proved correct in every detail by subsequent development.

Professor Bateson says:

" At first sight I should suppose silver to be a recessive to red and that it would always breed true. This, however, you say, is not the case. If silvers, really, when mated together, throw reds, there must be some complication which we cannot yet represent. Provisionally, I should doubt the statement until incontrovertible evidence is produced.

" I am not perfectly clear what a silver is, but I take it that a silver fox is to a red fox what a silver tabby is to a common tabby, viz., the same thing devoid of the red or yellow element. It may be difficult to disentangle the relations of the colour when there is a series of gradational forms* and, in the first instance, I should try to get a family in which the distinction between the reds and the silvers was sharp. Then I should breed the silvers together—brother and sister if need be.

" From what you say, I infer that two silvers of opposite sexes cannot be gotten to start from. That being so, you must mate together the silvers produced which you will raise from the reds produced by mating red and silver—if only reds come. But, if silvers come, then mate them together or back with the silver parent.

" Apart from the great practical difficulties which there are in breeding foxes in domestication, I think you will easily fix a strain of silvers."

Professor Bateson outlined perfectly the fox-breeding experiences of ranchers. Those who have spent their time working with gradational forms like the cross

* Such as cross foxes.

or patched foxes do not know what they will get until mating tests are made. Those who have chosen two distinct colour types are able to breed out to the pure recessive type in two generations.

Mendel's Law of Hybrids.—Dr. Eugene Davenport makes an explanation of the action of Mendel's Law of Hybrids that will prove instructive to many readers. He says:

" When diverse characters are thus brought together two very different results may follow. They may blend into a single new character, in which case our figures show the *proportions within the blood*, or they may remain distinct as two independent characters within the same individual. Stature and size as well as many colours blend freely, but not all characters behave in that simple way. For example, white and black blend freely in the human race, and the offspring of white and negro are mulattoes of various shades, according to the respective infusions; but colours do not blend in pigs, which are either black, white or spotted, never roan or mulatto. Some colours blend in horses (roan); some do not. Some breeds of cattle have blended colours (shorthorns); in others, the colours remain distinct (Holstein-Friesian.)

" And so with characters generally. Many will blend and many others will not. When they will not blend, then the appearance is still less a guide to the real hereditary qualities, and under these circumstances it is little or no index to what will happen when the mixture is bred. This fact was long a great stumbling-block to breeders, involving the business of improvement in unfortunate and as we now know, unnecessary mystery."

Silver Colour Mendelian Recessive to Red.—Suppose that a breeder has a silver fox, which, being recessive, always breeds true, and he chooses a pure type of red fox for a mate, being careful in order to secure pureness of type to obtain the red fox from a district where no melanism exists. Let the red fox be denoted by R.R. and the black or silver fox by B.B. (As to results, the sexes are equal in influence.)

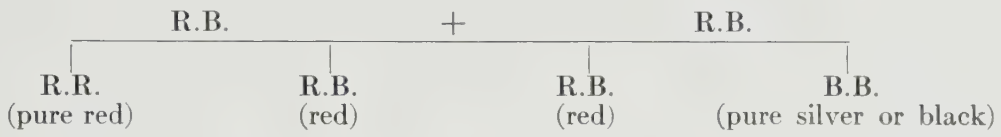
All pups are red, but of the bastard type mentioned above, with blacker points,—legs, muzzles and ears. They are really half black, but the colour is hidden or recessive in the first generation, red being dominant.

There are now two methods by which he can proceed to secure the black colour or pure B.B.

When diverse colours are mated in foxes the hybrid sometimes only, has the *proportions within the blood* and does not demonstrate its parentage by its colour until the second generation. When the crossing acts thus it is said to follow Mendel's law of hybrids. But often the result is a blend giving a hybrid which has a proportion of silver fur, i.e., a cross or patch fox. And it is not strange

that foxes in different districts breed thus for colour, as there are various examples of the same phenomenon in different breeds of animals. Holstein cattle segregate the colours; Shorthorns blend in some cases.

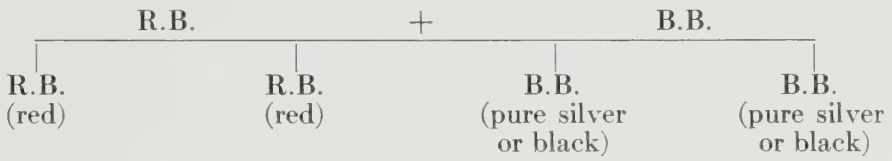
First method:



Results:

One-quarter of the litter is pure red.
One-half of the litter is red of the bastard type.
One-quarter of the litter is black or silver.

Second method:

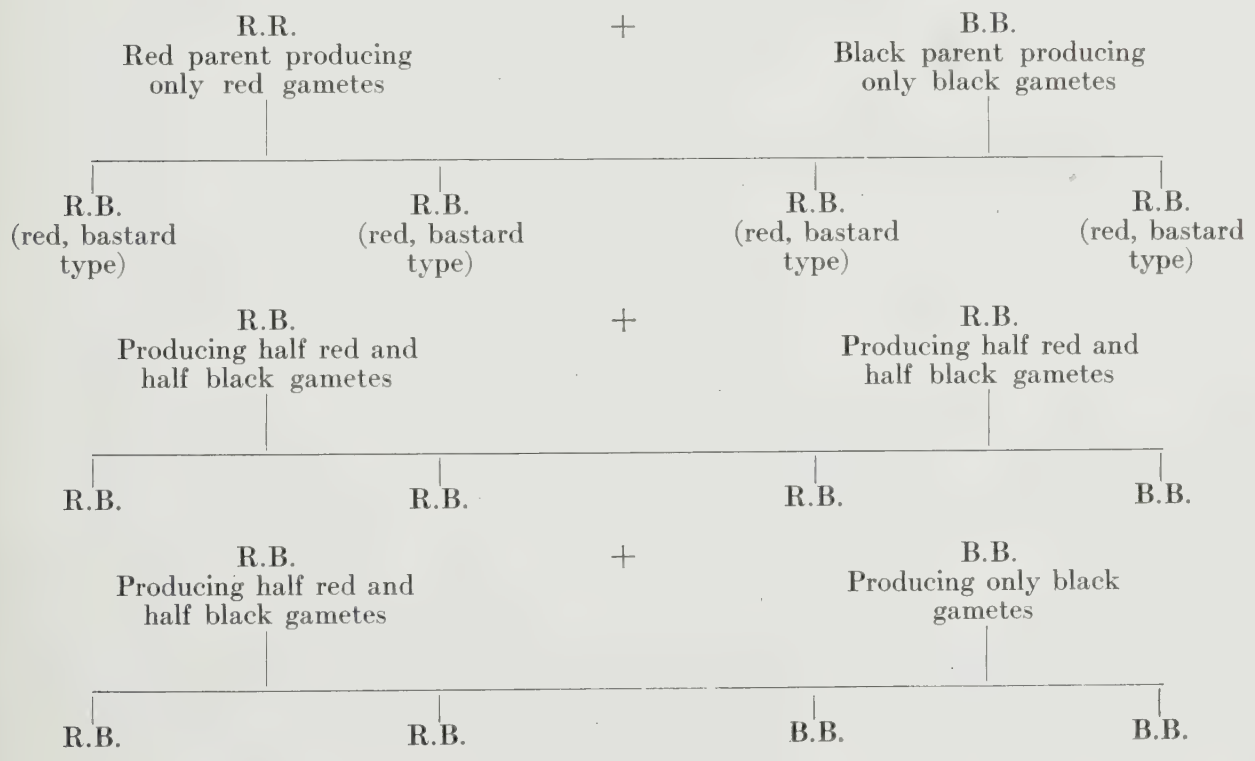


Results:

One-half of the litter is red of the bastard type.
One-half of the litter is pure black or silver.

Thus, it may be concluded that, in a district where melanism occurs, or where black and cross foxes occur, or either, there are very few foxes bred pure as to colour.

If the unit of union be regarded as of gametes which are produced by each parent in the proportion of its ancestors—red and silver—the results may be forecasted by a simple mathematical calculation, the law of probabilities governing the mating of the gametes.



It will be noticed that when the black colour (B.B.) appears the animal is always pure, while, R.R. is pure red and R.B. is also red with darker points.

It is well to bring out clearly the average results to be expected, as considerable speculation is indulged in as to whether or not certain foxes when bred to a silver will produce some silver pups. As much as $500.00 each has been paid for red pups that have one silver parent, because it is expected that, if the pup is mated to a silver, the resulting litter will be composed of silver and red foxes in about equal numbers. The hopes are realized in most instances; but many

Silver fox ranched in Russia. The pens were constructed from designs furnished by the Commission of Conservation

many chances of securing silver pups are lost because the breeder gets only red pups the first generation and becomes discouraged.

There is a wide-spread belief that the silver descendants of red foxes are rusty black in colour and are not as pure a type as those bred pure for generations in the fox ranches. Professor W. E. Castle, of Harvard University, says that only experiments will prove what quality will be obtained in the silver young of a red parent.* The results noted in this investigation indicate that some of the best skins ever produced are those of silvers having a red parent. There

* Professor Castle, replying to an inquiry, says:

"The several facts stated in your letter of November 14th, 1912, which I assume you have sufficiently verified, show clearly that black (or silver) coat character in foxes is a Mendelian recessive in relation to the common red coat and may be recovered in the second generation from a cross with red. Whether it would be improved or deteriorated as a consequence, experiment alone could show. I should think that the 'patch' or 'cross' foxes occasionally obtained in the F^1 generation might be well worth experimenting with, as indicating in that particular strain a tendency for the dominance to be reversed. If this tendency could be strengthened by judicious selection, a more potent strain of silvers might result. If, by this means, a strain potent enough to dominate F^1 could be secured, it is evident that silver foxes could be produced much more readily."

was difficulty in obtaining information on this important point, as breeders were extremely reticent in giving information concerning their experiences in cross-breeding with reds, because of a great prejudice against such breeding on Prince Edward Island. The prejudice, no doubt, results from an ignorance of Mendelian principles in segregating types.

It is interesting to note that Rev. George Clark, of St. Catharines, Ont., has in his possession a black dog fox obtained near York Factory, Hudson bay, which, he asserts, has sired none but silver pups when mated with any vixen. Of course, the five or six litters sired by one dog does not provide sufficient data from which to form a general conclusion. It may be that many of the six thousand or more red foxes kept in captivity will yet be crossed so as to produce a proportion of silver stock. As the red foxes were generally purchased from districts which produce very ordinary pelts, it is quite probable that, in many cases, the resulting silver will not be of good quality. The climatic conditions of Canada, however, which are very favourable to the production of good pelts may improve exotic sub-species.

If a prepotent race of silver foxes can be developed which will produce silver young by mating to red, thus reversing the supposed dominance of the red colour, the silver colour could be more readily produced; but the red colour would appear in the second generation. No record of such behaviour, other than the case mentioned above, was obtained, so that it is probable that breeders cannot get possession of prime silver foxes by breeding them from red ones other than by the usual method of mating a silver male of polygamic tendencies with red females.

Breeders are generally better pleased if cross foxes are produced the first generation; but, as a rule, if cross foxes are bred out, the tendency to produce an occasional red pup will never be wholly eliminated. Having cross foxes in the ancestry of silver foxes means that a proportion of red gametes are thrown and, at any time, a red fox may appear among the other silvers in a litter. Some cases of red or cross pups bred out of silver parents were recorded, but general experience, together with some evidence produced, favours the opinion that the parent foxes were animals captured in the wilds and probably had cross or patch parentage. It may be declared generally, that the silver colour is easily fixed and will practically always breed true after one or two generations of silver colour. Silver foxes can be produced of good silver colour by top-crossing cross foxes with silver for several generations and, if the silver foxes used in the crossing had ancestors of cross foxes, the probability is that a proportion of red, bastard, and cross foxes would appear among their offspring. All evidence tends to show, however, that very few, if any, with red colour on them are produced, and it clearly demonstrates that the blackness of foxes can be made practically permanent by top-crossing to silvers. After mixing red, cross and silver foxes for several generations, it is practically impossible to estimate the kind of pups that will come. Litters were seen that had red pups, cross pups and silver pups in them.

Practical Hints on Mink Farming.—The following practical hints on mink-farming have been recently published in circular form by the Biological Survey of the United States Department of Agriculture:

(1) Minks should be kept in the proportion of one male to five or six females.

(2) Each breeding female should have a separate pen. The male should be kept by himself except at mating time. The females begin to rut about the middle of February. The male should be admitted to the female for about one day. The young are born about the middle of April.

(3) The females must be kept alone or they will be likely to kill each other's young. The male would also kill them if he had an opportunity.

(4) *Food:* The best steady food for minks is bread and sweet milk, corn-mush and milk, or corn-mush cooked with bits of meat in it. The animals should have meat or fish about twice a week. The meat may be a very cheap kind. Keep pans clean and feed only as much as the mink will eat up clean at each feeding. Feed once a day, except females that are suckling young. These should be fed twice. Provide fresh water regularly. Do not salt the food.

(5) *Pens:* Pens should be 5 or 6 feet square, the sides of smooth, wide boards cut 4 feet long and set up with the lower end resting on a footing of stone or concrete 18 inches in the ground. The floor of the pen should be the bare ground. The pens can be built economically in groups of four or more. The sides can be of heavy wire netting instead of boards, but, in that case, the top would need to be netted or the animals would climb out.

(6) *Boxes:* Boxes about 2 feet by 1½ foot by 1½ foot in size should be provided for nests. They should have hinged lids so as to allow their being opened and examined. Fine straw or hay should be provided. The boxes may be outside the pens, bolted to the fence; a hole in the fence and box admits the animals, the box to be 3 or 4 inches above the ground. The boxes should be as dark as possible, with a hole 4 inches in diameter for the entrance of the minks.

In 1913, continued reports of success in breeding minks, were circulated and prices rose until they ruled at from $80.00 to $200.00 a pair according to quality and disposition. Ranch-bred minks are reputed to be more tractable than old wild ones and bring double prices. The rapidly growing interest in mink-ranching might, at first blush, be ascribed to the enthusiasm in Eastern Canada for fox-farming and to the successes achieved in that industry. A visit to one or two ranches however, furnished conclusive evidence that, when the initial difficulties have been overcome, mink ranching will become an important industry.

CHAPTER XI.

TRANSPORTATION

THE Yukon river is navigable from Bering sea to Whitehorse, a distance of over 2,000 miles, and, during the summer, from about the 10th of June until the 5th of October, this river is the great channel of transportation from the coast to the interior of the Yukon and Alaska. The railway of the White Pass and Yukon route extends from tidewater at Skagway, Alaska, where connection is made with ocean-going vessels, to Whitehorse, Y.T., on the headwaters of the Yukon river, a distance of 110 miles. This railroad crosses the coast range of mountains and at 19.7 miles from Skagway attains an altitude on the White Pass summit of 2,887 feet. At this point the railroad crosses

Steamer "Dawson" going through Five Finger rapids

the boundary between Alaska and British Columbia. The scenery between Skagway and White Pass is of the most wild and rugged description. From White Pass summit to Lake Bennett, B.C., the railway passes through the foothills of the coast range and then follows the shore of Lake Bennett where it enters the Yukon Territory and reaches Carcross which has an altitude of 2,171 feet and is 66.7 miles from Skagway. From Caribou Crossing to Whitehorse the railroad runs direct instead of following the wide detour of the chain of lakes and rivers, on which are located both Miles canon and Whitehorse rapids. From the head of the canyon the railway descends with a steep grade to the town of Whitehorse, which is situated at the head of navigation on Lewes river, the main tributary of the Yukon. Whitehorse is 110 miles from Skagway and has an altitude of 2,083 feet.

The Lewes river flows through Lake Lebarge which is about 26 miles from Whitehorse and has an altitude of 2,050 feet. This Lake impedes navigation in the early summer as the ice on the lake does not break up until about three weeks after the general break-up on the Yukon river. Emergency traffic is hauled from Whitehorse to the foot of Lake Lebarge and forwarded to Dawson on light-draft steamers. As soon as the ice breaks up on Lake Lebarge navigation is open between Whitehorse and Dawson and throughout the length of the Yukon river and its tributaries. The splendidly equipped fleet of steamers of the British Yukon Navigation Company of the White Pass and Yukon system then ply on regular schedules between Whitehorse and Dawson giving a service from the terminals about each alternate day but depending to a considerable extent upon the volume of traffic to be handled. The trip between Whitehorse and Dawson is made in two days (down-stream) and from Dawson to Whitehorse (up-stream) in four days.

The following are the official figures as to the opening and closing of navigation on the Yukon river since any records have been kept:—

Freeze-up	Year	Break-up
.....	1896	May 19..... 2.35 p.m.
.....	1897	" 17..... 4.30 p.m.
Nov. 4.....	1898	" 8..... 8.15 a.m.
Oct. 23.....	1899	" 17..... 4.10 p.m.
Nov. 2..... 5.00 a.m.	1900	" 8..... 6.00 a.m.
" 12..... 11.40 a.m.	1901	" 14..... 4.13 p.m.
" 5..... 1.15 a.m.	1902	" 11..... 8.45 p.m.
" 10..... 1.45 a.m.	1903	" 13..... 11.38 a.m.
" 8..... 8.50 a.m.	1904	" 7..... 9.44 a.m.
" 10..... 12.50 p.m.	1905	" 10..... 5.21 p.m.
" 7..... 5.15 a.m.	1906	" 11..... 7.45 a.m.
" 2..... 1.15 p.m.	1907	" 5..... 6.52 p.m.
Oct. 26..... 3.00 a.m.	1908	" 7..... 5.27 p.m.
Nov. 11.....	1909	" 11..... 9.47 p.m.
" 4.....	1910	" 11.....
" 8.....	1911	" 7.....
" 8.....	1912	" 9.....
" 7.....	1913	" 14.....
" 15.....	1914	" 10.....
.....	1915	" 3.....

During the period of open navigation through tariffs covering freight and passenger business between British Columbia and Puget Sound points also San Francisco, Cal., to points in the Yukon Territory, are effected. The rates for the season of 1915 are shown in Appendix No. 3.

Dawson to St. Michael

This stretch of the Yukon river, 1,601 miles, is commonly called the Lower river, and on this route steamers of the American Yukon Navigation Company

Scene on White Pass & Yukon Route

operate, making connections at Dawson with the upper river steamers of the White Pass and Yukon route, and at St. Michael with ocean-going vessels from Seattle and San Francisco. Freight destined for the interior of Alaska is largely routed via St. Michael, though the rates are much the same by the Upper river route, and the routing of freight is left entirely with the shippers.

Owing to the great distances in the interior and the variation of equipment required, the Lower river operations are divided into two sections on the main river. There are two or three splendid oil-burning vessels operating on the Dawson-Fairbanks run (975 miles) giving weekly service or better. These

vessels connect at Tanana, Alaska (700 miles from Dawson) with vessels operating thence to St. Michael (901 miles). This system gives connected service from the head of navigation at Whitehorse, Y.T., to Bering sea, with light steamer connections on tributaries.

The steamers of the British Yukon Navigation Company (White Pass and Yukon route) are wood burners, of which they consume some 8,000 cords during a season at a cost of about $46,000. Several of the steamers on the lower river are oil-burners. The supply of oil is imported from San Francisco in sufficiently large quantities to enable the steamers to operate until the close of navigation each year and to commence again at the opening of navigation the following year, before additional supplies of fuel can reach the interior. This necessitates the construction of large storage tanks at various places along the river.

Various estimates have been made of the discharge of the Yukon by both United States and Canadian engineers, but until 1911 it had not been found practicable to establish a regular gauging station on this river. In May, 1911, a station was established by the U.S. Geological Survey at Eagle, Alaska. As this town is very near the border line the results obtained are of equal interest to Canada.

The following table shows the mean monthly discharges since the station has been in operation:—

*MONTHLY DISCHARGE OF YUKON RIVER, AT EAGLE, ALASKA

Month	Mean discharge in second-feet			Second-feet per square mile		
	1911	1912	1913	1911	1912	1913
January	21,000	21,000	21,000	0.172	0.172	0.172
February	15,000	15,000	15,000	.123	.123	.123
March	11,000	11,000	11,000	.090	.090	.090
April	12,000	12,000	12,000	.098	.098	.098
May	156,000	125,000	117,000	1.28	1.02	.959
June	184,000	160,000	199,000	1.51	1.32	1.63
July	178,000	147,000	164,000	1.46	1.20	1.34
August	139,000	127,000	133,000	1.14	1.04	1.09
September	106,000	73,600	90,000	.869	.603	.738
October	60,000	51,000	55,000	.492	.418	.451
November	37,000	37,000	37,000	.303	.303	.303
December	28,000	28,000	28,000	.230	.230	.230

A maximum discharge was observed on May 22, 1911, when the discharge was 253,000 second-feet.

Of the area drained by the Yukon river about 150,768 square miles are in Canadian territory and 180,144 square miles in the United States territory of Alaska.

* Reprinted from "Water Powers of Manitoba, Saskatchewan and Alberta, 1915," by the Commission of Conservation.

When comparing the discharge of the Yukon with the following rivers, it should be noted that the discharge of the Yukon was taken at Eagle, Alaska, nearly 1,500 miles from its mouth:—

*Names	Area of drainage in square miles	Length in miles	Discharge in cubic feet per second		
			Low water	Mean	High water
Mississippi	1,226,000	4,000	447,200	.....	1,270,000
St. Lawrence	565,000	2,600	.....	900,000	.....
Ganges	432,000	1,680	36,300	207,000	494,200
Nile	520,200	2,240	23,100	220,000	.....
Thames	5,000	215	1,330	.....	7,900
Rhone	38,000	560	7,000	21,000	204,000
Rhine	80,000	700	13,400	33,700	164,000
Ottawa (Grenville)	80,000	700	35,000	85,000	150,000

* This is an extract from a table of various rivers contained in the General Report of the Minister of Public Works for the fifteen years from 1867 to 1882, and is reprinted from George M. Dawson's report of 1887 (No. 629).

First auto over Dawson to Whitehorse, winter trail

In the summer of 1902 the government built a winter road between Dawson and Whitehorse, a distance of approximately 333 miles, at a cost of $129,000. This road was maintained and used until 1912, when extensive changes were made in its location, with a view to making it available for summer use, and to serve the residents of the mining districts of the lower Stewart river. These changes also avoided a number of high summits traversed by the original road and which made it difficult and dangerous for travel. The new road, instead of

R.N.W.M. Police Patrol on their return from Fort MacPherson to Dawson, March, 1915

traversing a barren and uninhabited district between the Indian and Pelly rivers, now goes down Black Hills creek to the Stewart, through the ranches at Stewart river, and up to Scroggie creek to the original road near Pelly. Black Hills and Scroggie creeks have a considerable population of miners and will be producers for years to come. They are now on the main line of travel and can get their freight at reasonable rates at all seasons of the year. The original road overhung the Yukon river for a considerable distance at Minto bluff, and was constructed on cribbing. This was subject to slides and flooding and was always dangerous. This section of the road has been relocated and

placed through a comparatively level country back from the river. Similar stretches along the Yukon and Nordenskiold rivers were changed and improved in the same way, and many miles of the road which formerly traversed swamps which were only satisfactory when frozen have now been constructed on dry ground and graded.

The road can now be used by automobiles during the dry periods, and in the autumn before the snowfall becomes too heavy. In the course of a very short time it will be suitable for motor traffic at any season of the year. As yet the volume of traffic has been so small that the use of motors by the general

Hazard of navigation
The break-up of Yukon river, at Dawson water-front, May 12th, 1914

public has not been very practicable. The British Yukon Navigation Company has had the contract from the Dominion government to deliver the mail during the winter to Dawson and way points, since the road was originally constructed, and uses horses and sleighs, both for the mail service and in handling freight and express. The sleighs are not of the same width as the ordinary automobile, so that travelling with the latter after the snow becomes deep is out of the question. The use of vehicles of a uniform width, or a material increase in motor traffic would overcome this difficulty.

Ferries capable of handling six-horse teams and wagons have been placed at the crossing of the Stewart, Pelly and Yukon rivers. At Yukon crossing an overhead carrier has been established for the transfer of freight, passengers and mail during the period when ice is running in the river.

In 1912 a winter trail from Dawson to Miller and Glacier creeks was constructed along the bank of the Yukon river to Swede creek, up Swede creek for 30 miles into the valley of the Sixtymile, which is followed to Miller and Glacier creeks, a distance of 70 miles. This had the effect of reducing freight rates to these points from 10c. to 3c. and 4c. per pound.

In 1913 a wagon road was constructed from the mouth of Hunker creek up the Klondike valley to Flat creek, and in 1914 this road was extended,

Closing of navigation
Steamer "Dawson" leaving Dawson for Whitehorse, October 17th, 1913, amid running ice in Yukon river

making a winter road from Dawson to Mayo in the Duncan mining district on the Stewart river by way of the valley of Flat creek and McQuesten river. This is a great improvement on the former trail, shortening the distance about 20 miles and avoiding five ranges of hills. The construction of this road had the effect of reducing the freight rate from 25c. to 10c. per pound.

Since 1912 an extensive road system has been built in the upper Stewart river district, connecting all of the mining creeks with the steamboat landing at Mayo.

The following statement shows the number of miles of wagon road constructed during the period from the 31st of March, 1909, to the 31st of March, 1915:—

	Wagon road	Sled road	Pack trail
1909—10	Miles	Miles	Miles
Wheaton road	3		
Whitehorse to Copper mine	2		
Black hills	13		
Klondike river	7		
Total	25		
1910—11			
West Dawson, Sunnydale	1¾		
Jensen—Lower Dominion	4½		
Thistle to Barker		14	
McKinnon creek			2½
Haggart creek	4½		
Black hills	5¾		
Total	16½	14	2½
1911—12			
Klondike river	16		
Dominion — Gold Run	3½		
Steel Fork	4		
Lovett	½		
Williams creek		2	
Fortymile			11½
Scroggie			5¾
Sunnydale road	1¼		
Total	25¼	2	17¼
1912—13			
Scroggie creek		3	
Black hills	5		
Moose creek		5	
Total	5	8	
1913—14			
Scroggie creek	51½		
Black hills	13		
Right Fork Scroggie	8		
Upper Stewart	9		
Glacier creek		40	
Dawson—Fortymile		50	
Matson creek			26
Nansen creek	9		
White river			8
Total	90½	90	34
1914—15			
Carmacks	4		
Montague	4		
Tahkena	3		
Upper Stewart	12		
Right Fork Scroggie	3		
Henderson		20	
Coffee creek			115
White river road			25
Klondike to Minto lake		80	
Total	26	100	140

The following table shows the distance and freight rates from Dawson to different points in the Territory:—

From	To	Distance	Freight rate, per lb.	
			Winter	Summer
		Miles	Cents	Cents
Dawson	Arlington roadhouse	10.25	¼	½
	Barker creek	80.00	.....	5
	Black hills, Discovery	55.00	.....	3
	Bear creek	7.33	¼	½
	Bonanza	15.00	¼	½
	Bedrock creek (Sixtymile)	65.00	9	10
	Boucher	43.00	5	6
	Caribou (Dominion)	31.60	1¼	1½
	Carmack's Forks	18.20	1	1
	Clear creek (Duncan creek district)	.....	.....	1½
	Dominion creek, Dome, via Ridge	25.40	1	1½
	Dominion creek, Upper Discovery	28.50	1	1½
	Dominion creek, Caribou	31.60	1¼	1½
	Dominion creek, Lower Discovery	33.40	1½	2
	Dominion creek, 7 below Lower	34.10	1½	2
	Dominion creek, 92 below Lower	40.60	1½	2
	Granville	54.00	2	2
	Duncan creek	184.00	25	.....
	Eldorado, head of	19.50	1	.....
	Glacier creek, Discovery	58.25	9	10
	Gold Bottom	18.30	¾	1
	Gold Run, head of (via Ridge waggon road)	35.75	2	2
	Gold Run, via Hunker, Summit and Ridge	38.93	.....	.....
	Gold Run, No. 27, via Ridge and Gold Run	44.00	2	2½
	Gold Run, via Hunker, Summit, Green, Gulch	54.25	.....	.....
	Gordon's landing	172.00	.....	.....
	Henderson creek, via Bonanza, Calder, etc	53.50	.....	.....
	Hunker creek, Gold Bottom	18.30	¾	1
	Hunker creek, Discovery	21.50	¾	1
	Hunker creek, head of	26.35	1	1½
	Indian river (via Calder)	29.25	2	3
	Last Chance	12.75	½	1
	Miller creek (Sixtymile)	61.50	9	10
	Montana creek	36.75	.....	.....
	McQuesten	105.00	.....	1½
	Quartz creek, 12 below A. Mack's	28.10	2	2½
	Steel creek	36.75	.....	.....
	Sulphur, 36 above Discovery	30.40	1½	2
	Sulphur, 2 below Discovery	34.06	1½	2
	Scroggie creek	101.00	.....	1¼
	Victoria gulch	16.50	1½	2
	Williams, Bonanza and Ridge	31.66	2	2

From	To	Distances	Freight rate, per lb.
		Miles	Cents
Dawson	Quartz	28.10	1
	Indian river	29.25	1
	Black hills	53.25	2
	Stewart crossing	79.25	3
	Alberta	99.00	4
	Wheeler's	121.00	5
	Pelly crossing	141.00	6
	Minto	166.00	7
	Yukon crossing	189.00	8
	Carmacks	209.00	9
	Montague	233.00	10
	Braeburn	255.00	11
	Nordenskold	276.00	12
	Little river	295.00	13
	Tahkini river crossing	318.00	14
	Whitehorse	340.00	15

The Yukon river

Side Streams Navigation Company, Limited

The Side Streams Navigation Company, Limited, have now been operating for six years on the tributaries of the Yukon river, namely: The White, Pelly, Stewart and Porcupine rivers.

This Company operates two steamboats known as the "Vidette" and "Pauline" and two gas boats known as the "Splagutus" and "Hazel B" with barges.

Weekly trips are made from Dawson to Mayo on the upper Stewart river from about May 20th to October 1st.

Boats are sent up the other rivers only when traders located near the heads of the different tributaries take in their yearly supplies, or when special trips are made for the purpose of supplying prospectors engaged in operations on these streams.

The company for the past two years has made a special effort to operate light draft gasoline boats with barges to the head waters of the different tributaries, and has met with great success, so that prospectors can now be transported to the head waters with their outfits at reasonable rates.

The rates quoted by the Side Streams Navigation Company, Limited, are as follows:—

Dawson to Fraser Fall, Stewart River

	Distance	Freight rate, per pound	Passenger rate, berth and meals included
	Miles	Cents	
Stewart city	68	¾	$10.00
Barker, Scroggie and Maisie May	96	1¼	15.00
Clear creek	162	1½	24.00
McQueston	172	1½	25.00
Mayo	250	2	35.00
Fraser falls	293	2½	40.00

Dawson to Rampart House, Porcupine River

Fort Yukon	377	.....	.....
Rampart house	602	3½*	75.00*
Gasoline boats can operate to Lepierre house	852	.....	.....

Dawson to Ross River, Pelly River

Selkirk	180	.....	.....
MacMillan	254	.....	.....
Ross river	427	3½*	75.00*
Hoole canyon	450	3½*	75.00*

* This rate is quoted on the basis of a cargo of twenty tons. Special rate made upon application to the Company.

Dawson to Kluane Lake

White river	80	.....	.....
Mouth of Donjek	170	3½	50.00
Kluane lake	291	7½	75.00

WHITE RIVER DISTRICT

* Kluane Route

(summer route)	Miles
From Whitehorse to Kluane (Near upper end lake Kluane) by Yukon Government wagon road	150
From Kluane to Jacquot's roadhouse (Near lower end lake Kluane) by trail	47
From Jacquot's roadhouse to Canyon city on White river, by trail	85
From Canyon city to Pan creek, by trail	17
From Canyon city to crossing of Beaver creek, by International Boundary	15
From Pan creek to mouth of Beaver creek, by trail	42

(winter route)	
From Whitehorse to lake Kluane, mouth of Cultus creek, by wagon road and sled road	155
From Cultus creek to Jacquot's roadhouse, across lake on ice	22
From Jacquot's roadhouse to Rabbit creek, by trail and ice	86
From mouth of Rabbit creek to Pan creek, over ice	14
From Pan creek to crossing of Beaver creek, by International Boundary, by trail and creek ice	6
From Pan creek to mouth of Beaver creek, by trail and creek ice	42

* Coffee Creek Trail Route

From the mouth of Coffee creek to the mouth of Beaver creek, by Yukon Government pack trail	80
From the mouth of Coffee creek to Canyon city, by Yukon Government pack trail	120
From the mouth of Beaver creek to Pan creek, by Yukon Government pack trail	42
From the mouth of Beaver creek to the crossing of this stream by the International Boundary, by trail	45
From Canyon city to Pan creek, by trail	17
From Canyon city to the crossing of Beaver creek by the International Boundary, by trail	15
From International Boundary to Chisana city	40

* White River Route

From the mouth of White river to the mouth of Ladue creek, by river	28
From the mouth of White river to the mouth of Katrina creek, by river	42
From the mouth of White river to the mouth of Donjek river, by river	65
From the mouth of White river to the mouth of Beaver creek, by river	85
From the mouth of Beaver creek to Pan creek, by Yukon Government pack trail	42
From the mouth of Beaver creek to the crossing of this stream by the International Boundary, by Yukon Government pack trail	45
From International Boundary to Chisana city, by trail	40

Boundary Route

From Dawson to International Boundary, by Miller creek wagon road	60
From wagon road to Beaver creek, by trail along Boundary line	170±
From crossing of Beaver creek by International Boundary, to Pan creek, by Yukon Government pack trail	6
From crossing of Beaver creek by International Boundary to Canyon city, by Yukon Government pack trail	15
From crossing of Beaver creek by International Boundary to Chisana city by trail	40

Freight

The through freight traffic is rated in a joint classification which has been adopted by the steamship lines operating into Skagway, and the White pass and Yukon route operating from Skagway to the interior. The terms "A. B. C." designated the rating of goods under the tariff rates, the application of these lettered terms is somewhat similar to a reversed rating 4th, 2nd and 1st

* Memoir No. 50, pp. 20 and 21, No. 51, Geological Series, Upper White River district, Yukon, by D. D. Cairnes (No. 1385).

classes of the Canadian official classification. While necessarily a large amount of freight is rated under "class rates," the bulk of tonnage is handled under "commodity tariff rates," which is limited in application to the period of most favourable navigation. If often happens that a considerable amount of freight accumulates at Whitehorse before navigation opens; also that after navigation opens a low stage of water exists which permits of handling but small cargoes until the latter part of June. There is generally a low stage of water near the

Cable ferry crossing Yukon, at Dawson

close of navigation. During these periods there is no wish to stimulate the movement of heavy freight traffic, which would necessitate storing in warehouses until conditions permitted its movement, and to avoid congestion at the close of navigation, and the necessity of storing goods at Whitehorse over winter. Therefore the period of application of commodity rates is restricted.

Winter Transportation

During the winter season and the entire period of closed navigation, from about October 15th to May 15th, when the ice usually clears from the Yukon river below Lake Lebarge, the British Yukon Navigation Company operate an

overland stage line between Whitehorse and Dawson, a distance of approximately 340 miles.

The primary object of this overland service is for handling the government mail during the period of closed navigation. Its operation requires about 175 of the best type of stage horses, some sixty vehicles of different designs, also stabling facilities at each post on the route to accommodate from twelve to twenty-four animals. About 1,500 tons of feed is consumed annually on this

White pass

stage route, or about one-third of the total consumption of the Territory. The feed necessarily has to be imported during the period of open navigation, or from six months to more than one year before being required. It is hoped that in due time, improved trail conditions will enable overland operations by means of automobiles, thus eliminating the great expense of the present horse-drawn conveyances. Several gas-power vehicles of different designs are owned by the British Yukon Navigation Company and extensive experiments have been made with this end in view, but results have not yet demonstrated such reliability of service as to warrant a change of equipment.

From the close of navigation until sufficient snow has fallen to make good sleighing, concord coaches drawn by six horses are used, having a carrying capacity of ten passengers each. As soon as there is sufficient snow, sleighs are substituted. Each sleigh is drawn by four horses and has accommodation for about seventeen passengers with their hand baggage. The maximum length of a stage is 23 miles, and fresh horses are in readiness at each station to replace those that have completed that distance. There are in all fifteen stations on the

Shooting Miles canyon and rapids

line. At each station there is a road house with ample accommodation for the travelling public, and the service compares favourably with the best hotels of the country.

During the period of sleighing the stages are run on a schedule which makes ample provision for meets and for over-night stops. Three posts a day are made, and the run between Whitehorse and Dawson is made in five days, including the stop-over each night at a road house. This schedule allows for ample rest of the passengers. Starting each morning at 6 o'clock, lunches are served at the different stations at 10 a.m. and 2 p.m., and the day's journey is completed at 6 o'clock in the evening.

In addition to carrying government mail this stage line carries both passengers and freight. During the months of February and March, when trail conditions are best and traffic heaviest, almost daily service is given, depending upon the volume of business, as a daily service can be given with the available equipment if necessary. During the balance of the winter season the traffic is generally very light and trail conditions uncertain.

The passenger and freight rates by overland trail are shown in Appendix No. 4.

Express Service.

The interior of the Yukon Territory and Alaska is served by the Wells Fargo Express Company, which gives satisfactory service during both the summer and winter seasons to all points on the White pass and Yukon route, as well as many places off the main avenues of transportation. This company entered the northern field in May, 1911, and established a reliable express service, superseding several local organizations that had for some time furnished the public with an express service of an intermittent character. It operates in connection with the various Canadian Express companies at Vancouver, and with the American companies at Seattle, thus establishing a through line of service reaching all points and countries.

On opening business in Dawson in 1911, the Company placed money orders on sale at the rate of thirty cents per hundred dollars, thus reducing the rate of exchange from sixty cents per hundred, which had prevailed prior to that time.

Special effort has been directed and perfected for the safe carriage of gold bullion from Dawson, and from other producing camps of the north. Large steel safes of special design have been constructed for the conveyance of such shipments from Dawson to their destination, eliminating the danger of theft.

RATES ON GOLD BULLION

Dawson to Vancouver, or Seattle—$4.00 per $1,000.

Dawson to San Francisco, $4.50 per $1,000.

These rates cover marine risks and losses of any nature, excepting war risk, which at present is about one-tenth of one per cent.

Packages of Express Matter (Summer Service)

Vancouver, Seattle, Wash., to Dawson, $10.00 per 100 lbs.

Vancouver, Seattle, Wash., to Whitehorse, $9.00 per 100 lbs.

CHAPTER XII.

AGRICULTURE

THOUGH the agricultural resources of the Yukon are beyond doubt of considerable economic value, yet it must not be considered that the territory is suitable for occupation, at the present time, by a large number of agriculturists depending absolutely upon this industry. A large agricultural community can only exist in a country where the produce of such an industry can be disposed of at a reasonable profit, or where access can be obtained to markets at a distance, provided transportation rates will permit of fair competition. In the Yukon the principal industry is mining, and agricultural development must necessarily proceed according to the requirements of the population engaged in the mining industry. Farming operations can only be successful so long as those who are engaged in agricultural pursuits produce no more than is required for consumption within the territory. Careful and systematic farming operations, with due regard to the peculiarities of the climate, would abolish the importation into the Yukon of many of the agricultural products required by the people of Dawson and surrounding districts. If hay, oats, potatoes, etc., were grown in such quantities as would supply the local market, the price would be much less than is paid at the present time for imported products, the transportation rates would be avoided and the consumer would derive the benefit.

It was computed by Dr. Dawson in 1887 that within the drainage area of the Yukon, as far north as Fort Selkirk, there was an area of 60,000 square miles, of which a large proportion might be utilized for the cultivation of crops, and in which cattle and horses could be maintained for local purposes. Since that time there have been discovered other important agricultural districts, which would afford ample scope for farming operations, and the extent of territory available for agricultural purposes is greatly in excess of the area computed by Dr. Dawson. It might be interesting to quote here an extract from Dr. Dawson's report of 1887, showing how much he was impressed at that time by the agricultural possibilities of the Yukon; and it is also important to note that his remarks had immediate reference to the Pelly river district and the valley of the Lewes:—

"To instance a region which produces the general conditions of the Yukon district and adjacent northern portions of British Columbia, we must turn to the inland provinces of Russia, to which allusion has already been made in connection with climatic features. The province of Vologda, in European Russia, appears to offer the nearest parallel. It is circumstanced relatively

to the western shores of Europe as is this district to the western shores of the North American continent. Its area is 155,498 square miles, situated between the 58th and 65th degrees of latitude. The climate in both cases is a continental one, in which severe winters alternate with warm summers, and the actual degrees of cold and heat, as far as our information goes, are not dissimilar. There is no very heavy rainfall in either region, such as we find near the western coasts bordering on the Atlantic and on the Pacific respectively. The agricultural

Oat field on Hunker creek

products from the province of Vologda are oats, rye, barley, hemp, flax and pulse. The mineral products comprise salt, copper, iron and marble, but the precious metals do not appear to be important, as in the Yukon district. Horses and cattle are reared, and the skins of various wild animals, as well as pitch and turpentine, are among the exports. The population of the province is 1,161,000."

There is no reason why the agricultural products grown in the province of Vologda should not be grown equally as well in the Yukon. During the past few years comparatively large quantities of oats, potatoes and vegetables have been grown along the Yukon valley, particularly in the vicinity of Dawson, and in nearly all cases excellent results have been obtained.

The prices obtained for the various products vary considerably with the season. When sold by the sack, four cents per pound would be a fair average price for potatoes, turnips, carrots, etc. Oat hay sells for $80.00 per ton.

In addition to the field crops, considerable quantities of tomatoes, lettuce, cucumbers and radishes are grown. Tomatoes when first on the market about the 15th of June are one dollar per pound, the price becomes less as the season advances and when plentiful are three pounds for one dollar. Cucumbers sell for twenty-five cents each and lettuce and radishes two small bunches for twenty-five cents.

Alfalfa Growing

The United States Department of Agriculture has an experimental station at Rampart, which is located in the Yukon valley, one and one-half degrees north of Dawson, and what can be accomplished at Rampart in agricultural operations can no doubt also be accomplished in the Yukon.

In the annual report, 1913, of Mr. C. C. Georgeson, special agent in charge of the Alaska agricultural experiment stations, the following interesting statement was made on the subject of alfalfa growing at the Rampart station:—

" The most important step to report this year is the fact that seed was matured on two species of alfalfa, namely, on a hardy strain of Grimm alfalfa, which is a variety of Medicago sativa, and also on the yellow-flowered Siberian alfalfa, M. falcata. This accomplishment is of the greatest possible significance, for if hardy varieties of this valuable agricultural plant can be perpetuated by producing Alaska-grown seed, then alfalfa growing can probably be extended throughout other agricultural regions of the interior. This means that the Alaska farmer in suitable regions can produce this nutritious hay and that he can raise live stock to the extent of his needs. It means, further, that the fertility of the soil can be maintained and increased. Alfalfa, in common with other legumes, is a gatherer of nitrogen from the air, and since nitrogen, of all the elements of plant food, is the one that is most readily exhausted and the costliest to replace if it must be purchased in the form of fertilizers, the fact that a crop can be grown which enriches the soil in this element is a matter of great economic value.

" This is the first time that the small plats of alfalfa have produced seed. It took two years for the plants to become thoroughly established. The test was unusually severe; indeed, so severe that if seed could mature during the past season there is little probability that it will fail in any season. Part of the seed had been matured and was gathered before the severe frost in the latter part of August, but the bulk of the seed was not gathered until the freeze was over, and it was therefore exposed to the full force of the cold wave. Germination tests have proved that this seed was but slightly, if at all, injured by the frost. Alfalfa growing for the production of seed will be extended, and experiments with the several varieties and species now under cultivation, as well as the new strains which can be obtained from time to time, will be continued

and extended. There are at present 14 species and varieties of alfalfa growing at the station. Nitrogen-fixing bacteria have been established on the roots of some of this alfalfa."

The result of these experiments at the Rampart station is described by Mr. Georgeson in his report of 1914, as follows:—

"The failure of most of the varieties to live through another winter has somewhat dimmed the rosy hopes of immediate success with alfalfa. The follow-

Potato field near Dawson

ing varieties were frozen out:—yellow-flowered–North Sweden, Cossack, Samara and Medicago Ruthenica; purple-flowered–Grimm, Mongolian, Cherno, Sand lucern and Turkestan. The few that did winter successfully for the third time are Medicago falcata, Obb, and Gobi Desert. The last two are recumbent and did not ripen seed last year (1913), hence are less valuable than Medicago falcata, which grows erect, podded freely last year, and ripened considerable seed. This year there were plenty of pods but none ripened. This plat is as nearly perfect after three winters as it was the first summer, and the growth is vigorous; in fact, the stand is better because of the many young plants produced by last year's seed crop, some of which was shattered when harvested. Next

spring these young plants will be transplanted into rows 28 inches apart and 18 inches in the row so as to permit of cultivation and to emphasize seed production.

"The alfalfa seed that ripened last year was seeded thinly in rows 28 inches apart, covering about 1 acre, the greater part of which is Grimm. Other varieties are Sand lucern, Mongolian, Cherno and Medicago falcata. With the exception of the last named a good stand was secured and a vigorous growth resulted, standing knee-high by the end of the season. The newly seeded plat of Medicago falcata is on a knoll and the poor stand and light growth are no doubt due to the drier and poorer soil.

" Field plats of about one-eighth acre each were seeded to Vicia cracca, Semopalatinsk and Disco. Of the latter, there were four plats of the same variety but different strains. Vicia cracca is a vinelike plant much resembling winter vetch. A small plat seeded four years ago made quite a satisfactory growth each season. A good stand was secured this year and a fair growth by the end of the season. Cossack and Semopalatinsk are yellow-flowered alfalfas. Previous seedings of these two lived over two winters but froze out last year (1913-14). Disco alfalfa is a purple-flowered strain grown in South-Dakota and tried here for the first time.

" Trifolium lupinaster again gave a good account of itself, ripening a fair amount of seed in a season so unfavourable that none of the alfalfas produced seed. A one-tenth acre plat was seeded this spring, using the seed ripened last year. While this plant is not as valuable as alfalfa from the standpoint of forage, its perfect winter hardiness and seed ripening propensity give it a permanent place in the experimental plats here. It is not improbable that these more desirable qualities could be combined with the more luxuriant growth of some allied plant.

" It is expected that considerable time will be expended in the hybridization of alfalfa next summer. On the station farm are now several strong growing varieties of purple-flowered alfalfa, such as Grimm, Sand lucern, Mongolian and Cherno. None of these is perfectly winter hardy, although all wintered three years and ripened seed in 1913. In contrast with the above are the yellow-flowered varieties, notably Medicago falcata, Gobi Desert and Obb, which so far have shown themselves to be perfectly cold resistant, but are not as strong growers as the purple varieties, nor do they seed as freely. The problem, therefore, is to combine these several factors by hybridization."

Oats

" Oats made the best grain crop of the season, although the season was unfavourable for most crops; every plat of oats fully ripened. One field of 3 acres was seeded with Finnish Black oats, May 25, and while the growth of straw was not heavy, it bore well-filled heads and stood up until cut with the binder.

Report of the Alaska Agricultural Experiment Stations, 1914, by C. C. Georgeson, Special Agent in Charge, U.S. Department of Agriculture, pp. 56 and 57, issued July 22, 1915.

After standing shocked until thoroughly dry, the oats were stacked in the barn, where they will remain until thrashed in the spring. In another field one-fifth acre plats of Norwegian and Finnish Black oats were seeded, a one-tenth acre plat of Yakutsk and 1 acre of South Dakota. Most of this ground had been in potatoes the previous year, consequently the growth was strong and the heads large and well filled. All were cut with the binder except the plat of Yakutsk, which lodged so badly that it had to be cut by hand. A one-half acre field was seeded with Copperfield oats, which made a good growth and ripened early, but

A field of potatoes near Dawson

unfortunately it also lodged in places and it was cut with a cradle. This grain is a gray mutant of Finnish Black, but is inferior to that variety because of its propensity to lodge."

Potatoes

"One acre of ground was planted with potatoes May 17 and 18. They were hand dropped in furrows and covered by a specially constructed drag in the same manner as last year. As usual, the ground was in excellent condition and a good stand resulted. The potatoes began coming up June 3 and were in

Report of the Alaska Agricultural Experiment Stations, 1914, by C. C. Georgeson, Special Agent in Charge, pp. 61 and 62, U.S. Department of Agriculture, issued July 22, 1915.

bloom a month later. July 20, new potatoes were large enough to use. August 18, the tops were completely frozen to the ground. Digging was begun September 15 and finished September 17.

"The crop was considerably below average, due to a combination of poor soil, dry June, and early August frost. This year's result again emphasizes the fact that the hillside land on the farm is too poor, if unfertilized, to grow successful crops. However, the object in growing potatoes on the experiment farm is not altogether for the immediate crop, but largely to prepare the land for succeeding crops of grain. Experiments, both here and at the Fairbanks station, show that crops following potatoes do better than on summer fallow. However, selection of the most promising varieties was continued.

"Fifty-three varieties were grown, including Irish Cobbler, Burpee Superior and Extra Early Pioneer, which constituted the main crop. In determining the percentage of yield Irish Cobbler was taken as standard."

Vegetables

"The garden planted was as usual this year except that considerable more space was given to peas. As heretofore, the peas were sprouted in sawdust about a week before planting. This requires more work, but the extra time and labour are well rewarded by a perfect stand, extra early pods for the table, and ripe seeds for the next season's planting.

"About 200 hills of Irish Cobbler and Burpee Superior potatoes were also sprouted in sawdust-filled plats. When planted, each seed piece was a mass of roots and had stocky sprouts from 2 to 4 inches long. They were planted May 22 and began blooming 12 days later. In spite of the fact that the tops were frozen to the ground August 18, several days earlier than normal, a most excellent crop was dug, several potatoes weighing a little over a pound each. However, it was quality rather than quantity that was sought; and in that respect the result was all that could be asked. The potatoes cooked drier and were of better flavor than the field grown.

"It must be remembered that the seed potatoes for the field were also sprouted before planting, only not to the extent of growing roots on the seed pieces. Of course, such a method can be carried out in a small way only. But for the garden it will be found well worth while. Simply take a shallow box, a milk case ripped in two edgewise answers admirably for two, sprinkle a layer of sawdust, sand, or pulverized soil in the bottom, lay in the seed, then cover, filling the box level full. Put in a moderately warm place and keep moist. This should be done at least six weeks before planting time. If kept too warm and dark the sprouts will grow long and spindling, a result which should be avoided.

"A number of varieties of broad beans were tried out in the hope that some might mature, but they were caught by the early frost, which injured some to the

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Report of the Alaska Agricultural Experiment Stations, 1914, by C. C. Georgeson, Special Agent in Charge, pp. 62 and 63, U.S. Department of Agriculture, issued July 22, 1915.

Report of the Alaska Agricultural Experiment Stations, 1914, by C. C. Georgeson, Special Agent in Charge, pp. 64 and 65, U.S. Department of Agriculture, issued July 22, 1915.

extent of killing all the pods. On a few plants, only the young pods suffered. The leaves of all were but slightly injured.

" The varieties were Sutton Giant Windsor, which grew to a height of 16 inches; flowers, white with purple and black centres; no pods formed. Brown Hangchow, purple flowers, no pods. Beck Dwarf Green Gem, white-flowered, no pods. Green Hangchow, flowers purple, striped with black centres, bore an abundance of pods, some of which were 4 inches long. This variety was less injured by frost than others. Pamsca, flowers same as Giant Windsor, not prolific, but bearing large pods. Murciana, flowers same as Giant Windsor, grew large pods, some being 7 inches long. Sutton Green Giant, flowers same as Giant Windsor, fairly prolific, largest pods 5 inches. The beans of several varieties were cooked and found to be very savory.

" Trial plats of several types of turnips were grown and gave promising results. The type shape is similar to a rutabaga, but the roots are smooth without laterals. Color, bright yellow. One variety had a purple top. They are of most excellent flavour when cooked. The best roots will be planted next year for the production of seed. The varieties grown are Ostersundom, Bortfelder, Yellow Swedish, Bangholm and Yellow Tankard.

" Several pounds of turnip seeds were produced. The seed, as usual, is plump and heavy with a high percentage viable. More space will be devoted to the production of turnip seed, especially the variety known as Petrowski. This is a yellow imported sort and wherever grown in Alaska has evoked words of praise.

" Half a dozen roots of white winter radish were put out early in the spring. Three of them produced large plants which podded freely and by fall the pods were filled with large, plump, ripe seed. Like most root crops grown in Alaska, winter radish attains great perfection. They may be eaten as a relish and make a most excellent salad throughout the long winter season."

Report of the Alaska Agricultural Experiment Stations, 1914, by C. C. Georgeson, Special Agent in Charge, pp. 64 and 65, U.S. Department of Agriculture, issued July 22, 1915.

CHAPTER XIII.

GENERAL INFORMATION

Education

A SUPERINTENDENT of schools for the Yukon Territory was appointed in 1902, and in the same year a general system of education was inaugurated throughout the Territory. The course of study prescribed is similar to that adopted by the new provinces of Alberta and Saskatchewan. No teachers are employed unless they hold at least a second-class certificate, with normal training, and efforts have been made to employ only specialists in the Dawson public school. The teachers in this school have been selected from some of the best educational institutions in Canada.

The high school branch of the Dawson public school was instituted in 1903. There are two teachers in charge of this branch, one a specialist in classics, modern languages and history, the other a specialist in mathematics and science. In 1904 a laboratory was established with apparatus and materials for the prescribed work in physics and chemistry.

Since July 1905, by arrangement with the University of Toronto and the Department of Education of the Province of Ontario, Dawson has been a local centre for holding the Ontario matriculation examinations. Quite a number of Dawson high school students have passed this examination, several obtaining honours in various branches.

A considerable number of Dawson graduates have taken or are taking successful courses in Arts, Law, Medicine or Engineering at various universities, *e.g.*, Toronto, McGill, Chicago, Leland Stanford, Colorado, Nevada and Yale.

There are eight rooms in the Dawson public school, three of which are devoted to high school purposes, and one to the kindergarten, the latter being supplied with complete equipment for this work. Fire exits are provided for every room, and a regular fire drill is practised by the pupils, who can vacate the building in half a minute after the sounding of an alarm.

In certain districts, where the number of children does not warrant the establishment of a regular school under the provisions of the school ordinance, regulations have been made by the Commissioner for the establishment of 'assisted schools,' but the average attendance must be at least five pupils between the ages of six and sixteen, and the course of studies prescribed by the Council of Public Instruction. Teachers of 'assisted schools' are also appointed subject to the approval of the Commissioner and Superintendent of Schools.

Climate

Professor John Macoun, in a report on the climate and flora of the Yukon Territory, described the effect of the Coast range of mountains on the climate, as follows:—

"Instead of the Coast range being an injury to the interior, it makes the climate pleasant both in summer and winter. The Yukon district has two

Dawson public school

climates, a wet and cold one on the coast, which may be called the Alaskan climate, as nearly all the coast region belongs to the United States. The climate of the Yukon district in Canada is just the reverse, being dry and warm in summer and cold in winter, with a light snowfall. Owing to the moisture rising from the warm Japanese current being carried inland by the upper south-west air current and striking the Coast range, this moisture is at once precipitated on the sea face of these mountains in the form of rain or snow, and the air freed from its moisture descends on the Yukon plain as dry air, and having an increased temperature. It follows that the rainfall must be light in summer and also the snowfall in winter."

TABLE SHOWING MAXIMUM, MINIMUM AND MEAN TEMPERATURES IN YUKON, BETWEEN OCTOBER, 1900, AND MARCH, 1915

Year	January			February			March			April			May			June		
	Maximum temperature	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean
1900																		
1901		—68		18	—49		41	—36	11.2	35	—11	24.4	68	18		81	37	55.6
1902	16	—51		1	—47		33	—41		54	—14		73	25		85	35	
1903	14	—59	–27	14	—53	– 5	35	—31	4.7	53	—18	22.6	65	18	42	89	34	57.2
1904	20	—57	–22.4	—3	—48	–25	35	—38	—4.5	54	— 0	32.5	67	25	42.2	74	33	53.5
1905	5	—50	–23.8	24	—37	6	42	—18	11.4	53	10	34.2	78	33	51	81	33	60
1906	13	—65.5	–33.2	12	—39	–12.5	35	—12	10.8	58	—11	25.7	79	24	49	85	41	62.3
1907	18	—59	–23.6	45	—55	–26.8	33	—39	—3.5	61	—29	30	78	23	52.5	87	31	59.4
1908	30	—42	–13	35	—44	– 9.5	35	—42	—8.8	57	— 8	23.2	77	33	49	14	84	37
1909	12	—65	–43	13	—53	–28	46	—25	11.9	53	15	23	74	24	44.81	86	29	58.38
1910	29	—54	–20.08	5	—54	–26.60	45	—44	4.50	52	— 2	25.20	65	22	48.00	83	31	59.00
1911	2	—62	–35.17	45	—54	– 6.39	37	—41	2.30	59	—25	24.68	66	25	46.70	83	33	57.63
1912	20	—62	–17.05	40	—23	4.10	41	—22	11.60	55	— 0	37.34	76	24	53.84	79	31	52.73
1913	17	—57	–32.00	30	—43	– 6.00	42	—30	9.04	52	—10	28.63	71	22	48.92	74	33	58.43
1914	10	—52	–23.67	22	—36	.87	40	—16	9.40	59	—11	27.30	75	21	51.23	84	32	64.44
1915	18	—24	.09	3	—37	– 9.35	48	—15	17.04									

TABLE SHOWING MAXIMUM, MINIMUM AND MEAN TEMPERATURES IN YUKON, BETWEEN OCTOBER, 1900, AND MARCH, 1915—*Concluded*

Year	July			August			September			October			November			December		
	Maximum temperature	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean
1900											—12	19.4	10	—42	—17	17	—48	
1901	85	41		76	27	54	71	23		47	4		31	—36		21	—50	
1902	82	42		72	36		61	26		60	7		20	—48		29	—49	
1903	85	38	59	85	33	55.8	65	19	42	40	—4	20	40	—42	4.7	16	—33	- 0
1904	75	40	56.1	80	30	52	55	8		55	8	27	22	—27	—0.0	21	—31	2
1905	84	36	60.4	80	27	55	58	22		48	—0	23	32	—20	10.6	16	— 4	- 9
1906	80	39	66.1	78	30	55	68	15		50	12	36	27	—38	1.4	8	—55	-21
1907	88	39	60.7	79	30	56	64	24	42	49	—17	25	26	—30	.06	20	—41	- 5
1908	84	41	59	79	32	50	61	12	38.5	52	22	16	28	—25	.05	25	—49	- 8
1909	83	37	61.76	80	28	54.11	68	12	40.90	54	— 1	23.85	28	—45	9.51	19	—44	-31.50
1910	86	39	62.40	74	25	51.97	71	19	39.50	49	— 3	25.70	20	—25	1.35	10	—49	-17.10
1911	83	37	62.40	81	32	53.74	71	12	42.92	55	4	31.10	30	—31	—3.97	32	—36	5.88
1912	82	38	60.11	75	30	55.24	74	18	45.00	58	11	29.17	36	—48	2.75	31	43	-22.00
1913	83	39	64.00	80	23	55.63	69	11	43.46	54	— 9	22.70	47	—30	4.11	30	—38	- 6.46
1914	78	31	59.00	74	30	58.00	70	12	41.62	54	12	34.24	36	—20	8.40	20	—19	- 9.59
1915																		

TABLE SHOWING PRECIPITATION IN THE YUKON FOR EACH MONTH DURING A PERIOD OF FIFTEEN YEARS, AS COMPILED BY THE METEOROLOGICAL OBSERVER AT DAWSON, Y.T.

	Jan.		Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.		Total precipitation
	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	Precipitation	Number of rainy days	
1900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1901	.....	.....	.....	.....	.....	.....	.....	.....	0.70	....	0.94	2	1.32	3	0.54	5	1.17	5	2.25	7	1.10	6	1.55	6	.....
1902	1.70	9	0.20	1	....	0	0.55	2	0.40	2	0.86	3	3.32	8	2.30	14	1.17	9	0.92	8	1.10	4	1.00	5	13.52
1903	0.550	2	1.35	6	0.70	5	0.60	3	0.43	3	0.46	9	1.38	6	1.23	10	2.41	8	1.25	7	0.45	4	0.65	2	11.41
1904	0.70	9	0.31	6	0.11	2	0.78	6	0.76	6	1.71	8	2.14	11	1.80	10	1.26	7	0.56	3	0.60	6	1.45	6	12.20
1905	0.50	3	1.21	6	0.40	3	0.94	5	0.97	4	0.25	2	1.51	9	2.51	10	3.52	15	1.84	14	0.24	5	1.69	10	15.58
1906	1.23	11	0.52	11	0.22	7	0.46	6	2.00	9	0.92	9	1.20	15	1.44	11	1.06	9	0.56	12	1.58	11	0.92	8	12.11
1907	1.61	11	0.35	4	0.88	6	0.23	9	1.02	10	0.85	12	1.75	11	1.28	9	2.29	12	4.08	17	2.60	14	0.62	6	17.56
1908	0.71	10	1.00	8	0.71	7	1.22	10	1.43	14	1.23	14	2.91	17	1.08	9	1.33	12	0.69	9	1.59	....	2.00	....	15.90
1909	0.26	8	0.48	6	1.24	15	0.67	7	0.81	10	2.11	5	0.81	3	2.30	12	0.86	3	0.63	9	1.26	4	.....	.....	.....
1910	1.31	10	0.22	1	0.68	7	1.68	9	0.19	0	1.44	1	0.82	7	1.65	5	1.19	7	1.63	9	1.46	4	0.60	6	12.87
1911	1.52	6	0.91	5	0.77	8	1.30	4	1.66	11	0.88	5	1.31	2	1.39	4	0.86	6	0.43	3	1.05	10	1.70	11	13.78
1912	0.20	2	1.05	3	0.60	5	0.00	0	1.28	2	0.74	5	2.48	9	1.38	7	0.96	5	2.43	13	1.12	4	1.20	9	13.44
1913	0.60	3	0.99	7	0.78	6	1.02	5	1.03	4	0.76	5	2.04	7	0.87	5	1.20	3	0.00	5	0.82	9	1.44	8	11.55
1914	Trace	3	0.95	4	0.20	6	0.25	5	1.04	6	1.72	5	1.37	11	1.59	13	1.21	8	0.10	5	0.70	7	0.85	7	9.98
1915	0.30	11	0.50	3	0.42	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.....

Caribou on Dawson-Glacier trail, thirty miles from Dawson

Game

* The Yukon Territory contains some of the best sections of game country in Canada, and many trappers and prospectors have been able to live for long periods almost entirely on the proceeds of the rifle and net.

Of late years, however, game of all kinds has become very scarce in some localities, owing to the extensive killing carried on by those who hunt for the market offered by mining camps.

The Indians, having lately acquired high-power magazine guns, are responsible for a great deal of slaughter, as the average Indian who gets into a band of big game shoots as long as his cartridges hold out, whether he can use the meat or not. Head hunters who come into the country in search of fine specimens, do a great deal of damage, as they have been known after a day's hunting, to leave enough meat to spoil on a hillside to supply a prospector with provisions for a whole winter.

The moose is the chief game animal, and is still plentiful in the valleys of that part of the Pelly river and its tributaries which flow through the Mackenzie mountains. Almost any fine day in summer, from the top of a mountain, a few moose can be located in the valleys below, by the aid of a pair of field glasses.

The valley of the Ross river affords a good range for moose, as it is sprinkled with numerous small lakes, and several extensive willow patches, which furnish the most desirable food and environment.

Cariboo are found in small bands on some of the mountain groups on the Pelly, Macmillan and other rivers tributary to the Yukon. They select mountains of a subdued type, having large expanses of tableland, and as long as their favourite moss is plentiful do not leave that neighbourhood unless forced to.

It is true that cariboo collect in large numbers in the northern part of the Mackenzie mountains, and moving herds are frequently seen on the headwaters of the Klondike river, but there is no such herding or movement on the part of the small bands on the Pelly branches.

The mountain sheep are in small scattered bands, and inhabit only a few selected mountain groups. They require a feeding ground above timber line, from which the wind blows the snow in the winter time, and convenient crags to afford a place of retreat from enemies. During the summer the sheep venture down to the valleys, in search of alkaline clay, which they desire to lick at certain periods, but for the most part they keep above timber line.

The sheep on the Stewart river are all pure white, while those on the Macmillan and Pelly rivers range in colour from white to almost black.

The sheep are highly prized for their heads, and on account of their flesh, which is the best of all the wild meat, consequently they are hunted to extermination in any of the accessible localities.

Black, brown and grizzly bears are more or less numerous, but are not often met with, except in the month of August, when they come out along the banks of the Yukon tributaries to feed on the salmon.

* A reconnaissance across the Mackenzie mountains, on the Pelly, Ross and Gravel rivers, by Joseph Keele (No. 1097).

Black and grey timber wolves are scattered throughout the region, but they are very rarely seen during the summer months. In winter they assemble in packs, and make regular hunting trips up and down the valleys, killing large numbers of moose.

The salmon come up the Yukon river and its tributaries about the end of July, reach the spawning grounds in August, and are all dead by the end of that month.

Whitefish, inconnu and pike are found in greater or less abundance, in all the streams and lakes in the region. A net set in any favourable place rarely fails to take some of the above varieties.

Grayling are plentiful in the rivers, and can be easily taken with a rod and line, using an artificial fly for bait.

Great numbers of wild geese breed along the main rivers tributary to the Yukon, the nesting sites and feeding ground being among the willows and on the mud bars close to the streams. Scattered pairs of swans frequent the small lakes in the wide valleys during the summer, but they gather in large flocks in the late autumn before taking their departure to the south.

PEEL RIVER AND TRIBUTARIES

Moose, though found over the whole region explored as far as the delta of the Mackenzie river, are never as abundant as they are on the Yukon side of the divide, and on the Peel river itself are rather scarce.

Caribou are plentiful everywhere in the vicinity of the mountain ranges, some even being found on the plateau.

Bears, both black and grizzly, are plentiful near the summit of the divide, and numbers of them are seen all the way down the Peel river, and particularly on the Mackenzie delta and in the mountains to the west of it.

Numbers of white mountain sheep are seen on both Braine and Nash creeks. In the mountain section of the Wind river several of them are encountered on the banks of the stream, as well as the slopes of the valley. A small band was seen on Mount Goodenough, west of the Mackenzie delta, and they are said to be abundant in the mountain range to the west of this.

Grayling in the mountain sections, and whitefish, inconnu and pike in the lower parts of the district are the common fish of the country.

The Peel river district is inhabited by the Loucheux tribe of Indians, who trade with the Hudson's Bay Company at Fort McPherson. These obtain their living entirely by fishing in the summer, and trapping and hunting caribou in the winter. They make no attempt to build houses, and the cultivation of the ground is impossible, as the surface only thaws out during the summer for a few inches.

WHEATON DISTRICT

Until within the past two or three years Wheaton district abounded in several varieties of big game, including moose, caribou, sheep and bear, and

few places in North America would have been more attractive to sport-loving hunters. Since 1906, however, the prospectors and others frequenting the district have killed great numbers of the larger animals, and those remaining have been to a considerable extent driven back to the western and north-western portion of the area and the adjoining territory, where, however, they are still to be found in great numbers. Fresh, well-worn runways are everywhere to be seen throughout the district.

A mountain sheep

Moose, and sheep (*Ovis dalli*), as well as black, brown and grizzly bear are still fairly plentiful, but caribou (Osborn's caribou, *Rangifer osborni*) are less often seen, having mostly migrated to the adjoining country to the north-west. Wolves, wolverine, beaver, otter, martin and lynx are common, and red, cross, silver and even black foxes are occasionally to be found. Ptarmigan are exceedingly plentiful and three varieties were noted: the rock ptarmigan (*Lagopus rupestris*), and white-tailed ptarmigan (*Lagopus leucurus*) are found above timber line, and during the summer months live mainly on the highest, often

Memoir No. 31, p. 29, Wheaton district, Yukon Territory, by D. D. Cairnes (No. 1228).

snow-capped summits; the willow ptarmigan (*Lagopus lagopus*) live during the summer months at about timber line. Blue grouse or Richardson grouse (*Dendragopus Richardsonii*), fool hens or Franklin grouse (*Canachites franklinii*), willow grouse or Oregon ruffed grouse (*Bonasa umbellus sabini*) are fairly plentiful, and occasional prairie chicken or northern sharp-tailed grouse (*Pediaecetes phasianellus*) were also seen; these live mainly in the timber and preferably in the valley flats.

The streams are generally fairly well supplied with fish, chiefly greyling (*Thymallus signifer*); and in the lakes in this and the adjoining districts lake trout (*Solvelinus Namaycush*) and whitefish (*Coregonus Nelsoni*) abound.

UPPER WHITE RIVER DISTRICT

Game is plentiful throughout most parts of Upper White river district, sheep, moose, and caribou being particularly numerous. In fact, were this locality only slightly more accessible and somewhat better known, few places on the continent would be more attractive to the sport-loving hunter.

The sheep are the white Alaskan variety (*Ovis Dalli*); these feed during the winter months in the main valleys, but with the approach of summer, they work farther and farther back into the higher mountains, and choose especially the lofty, rugged, craggy summits, and are frequently found in the vicinity of glaciers. They rarely return to the valleys during the summer except in crossing from one mountain to another.

The moose are the large giant moose (*Alces gigas*); these magnificent animals range the lowlands in considerable numbers and are particularly plentiful in the flats bordering White river. Caribou are also somewhat numerous, and are frequently seen on the low open hills in different parts of the district. They are, when seen, the least difficult of any game to procure, as their curiosity is greater than their fear, and they will follow a horse or watch a man until scent gives them warning. Black and grizzly bears are sufficiently numerous to make it unsafe to leave a cache unprotected for more than a day or two, and they have been known to disturb provisions in the presence of the owner. Rabbits also abound throughout the district. Lynx, mink, martin, wolverine and red fox are fairly numerous and cross, silver and black foxes are occasionally found.

The chief game birds noted are rock ptarmigan (*Lagopus rupestris rupestris* Gmelin), willow ptarmigan (*Lagopus lagopus*), Alaska spruce partridge (*Canachites canadensis osgoodi* Bishop), fool hens or Franklin grouse (*Canachites franklinii*), willow grouse or Oregon ruffed grouse (*Bonasa umbellus sabini*), and several varieties of ducks and geese. The rock ptarmigan are found above timber line, and, during the summer months, live mainly on the highest, often snow-capped summits; the willow ptarmigan live during the summer season at above timber line. Both varieties are very plentiful in Upper White river district as well as in adjoining portions of Yukon and Alaska. These birds are very easily obtained and can often be secured with sticks or stones.

Memoir No. 50, p. 18, No. 51, Geological Series, Upper White river district, Yukon, by D. D. Cairnes.

PORCUPINE AND YUKON RIVERS

* Big game is plentiful throughout a great part of this belt between Yukon and Porcupine rivers. In fact were certain localities within this belt only somewhat more accessible and slightly better known, few places on the continent would be more attractive to the sportsman. Moose, caribou and sheep occur throughout the district and are very numerous in certain localities. The moose are the large giant moose (*Alces gigas*); these magnificent animals are very plentiful, particularly to the south of Black river. One specimen secured, and which was far from being a record animal for the district, had a spread of antlers of just 60 inches and was estimated to weigh at least 1,500 pounds live weight. The caribou are of two varieties, the Barren Lands caribou and the giant or Osborne caribou (*Rangifer osborni*). The giant caribou is frequently seen either one or two at a time or in small herds of 20 or 30 individuals. Between Porcupine river and the Arctic ocean, there are also vast herds of Barren Lands caribou which trek to the south of the Porcupine after the " freeze-up " in the autumn.

The sheep have been thought to be all Dall's mountain sheep, the variety common to Yukon and Alaska, and, undoubtedly some, if not all, are of this species; numerous individuals are seen, however, in different places and within distances of 100 yards or less, which appeared to be smaller and lighter in colour than Dall's sheep. The sheep live in the summers on the high limestone mountains, and are sometimes found in flocks of 60 or 70 or even more. Black, brown and grizzly bears are also plentiful throughout the belt and with wolves, wolverine, martin, lynx, ermine and fox, constitute the chief fur-bearing animals of the district.

The rivers are generally well supplied with fish, mainly a variety of grayling, whitefish, King salmon and pike. The smaller streams as a rule contain only the grayling which, however, are very plentiful in most places.

SYNOPSIS OF THE GAME ORDINANCE OF THE YUKON TERRITORY

Under the Ordinance Respecting the Preservation of Game in the Yukon Territory and amendments thereto, the Close Seasons, within which the undermentioned beasts and birds shall not be hunted, taken, killed, shot at, wounded, injured or molested in any way, are as follows, namely:—

Buffalo or Bison—The whole year.

Musk-ox, Elk or Wapiti, Moose, Caribou, Deer, Mountain Sheep or Mountain Goats—Between the 1st of March and 1st of September.

Grouse, Partridge, Pheasants, Ptarmigan and Prairie Chicken—Between 15th March and 1st of September.

Wild Swans, Wild Ducks, Wild Geese, Snipe, Sand-pipers or Cranes—Between the 1st of June and 10th of August.

* Memoir No. 67, p. 18, No. 49, Geological Series, the Yukon-Alaska International Boundary between Porcupine and Yukon rivers, by D. D. Cairnes.

Except as hereinafter provided, no person shall have the right to kill during the open season more than two elk or wapiti, two moose, two musk-oxen, six deer, six caribou, two mountain sheep and two mountain goats. No females shall be killed at any time.

Eggs on the nests of any of the birds mentioned or any species of wild fowl, shall not be taken, destroyed, injured or molested at any time of the year.

No person who is not a resident of the Territory shall have the right to hunt, take, kill, shoot at or carry away any of the beasts and birds mentioned unless he has obtained a license from the Commissioner of the Territory or a Game Guardian, who shall also have authority to issue permits for the export of trophies. The license fee is $100.00, and all persons holding licenses must furnish particulars under oath to the Game Guardian.

Game Guardians have the right to inspect any bag or other receptacle, vehicle or other means of transportation, when they suspect that any person is illegally in the possession of game.

Beasts or birds may be lawfully taken, hunted or killed, and eggs of any birds or other wild fowl may be taken during the close season only:

1. By explorers, surveyors, prospectors, miners or travellers who are engaged in any exploration, survey or mining operations, or other examination of the Territory, and are in actual need of the beasts, birds or eggs for food.

2. By any person who has a permit to do so granted under the subsequent provisions of the Ordinance:

(*a*) To whom a permit has been issued to take or kill, for scientific purposes, or to take with a view to domestication, any number, to be fixed by the Commissioner, of each of the said beasts or birds, except buffalo and bison, or to take eggs not exceeding twelve of each of any of the said birds or of any other species of wild fowl;

(*b*) Hunters licensed by the Commissioner to provide sustenance for isolated camps in districts set aside by proclamation.

None of the contrivances for taking or killing wild fowl, known as batteries, swivel guns or sunken punts, shall be used at any time of the year, to take, destroy or kill any of the birds or wild fowl.

It shall be unlawful for any person to use poison or poisonous substances for the purpose of taking or killing any birds or beasts of any kind, and if any person places such poison or poisonous substances in such a position that it may be reached or taken by any bird or beast, it shall be proof that it was used for such purpose.

No dogs shall be used at any time of the year for hunting, taking, running, killing, injuring or in any way molesting buffalo or bison, or during the close season, any of the other beasts or birds.

No one shall enter into any contract or agreement with or employ any Indian or other person, whether such Indian or other person is an inhabitant of the country to which this Ordinance applies or not, to hunt, kill or take,

contrary to the provisions of the Ordinance, any of the beasts and birds mentioned, or to take, contrary to such provisions in the Ordinance, any eggs.

Any beast, bird or eggs in respect of which any conviction has been made shall be held to be thereby confiscated.

Possession shall be constituted as follows:—

1. Possession at any time of the year of a buffalo or bison, dead or alive, or any part of a buffalo or bison; or

2. Possession at any time of the year of eggs of any of the birds mentioned in the Ordinance or of eggs of any other species of wild fowl; or

3. Possession during the close season of any other beast mentioned in the Ordinance, or of any part of any such beast, or of any birds mentioned in section 3, shall be deemed *prima facie* evidence of the killing or taking of the beast, bird or eggs, as the case may be, contrary to the provisions of the Ordinance. Provided, moreover, that this section shall not be construed to prevent the exposure and offering of for sale the carcasses, or any part of them, of beasts killed during the open season, for a period of sixty days after the beginning of the close season.

Any person who kills any of the beasts or birds mentioned in the Ordinance, and does not use the meat thereof for food himself or cause the same to be used for food, or does not offer the same for sale in some market within the Yukon Territory, shall be liable to a penalty not exceeding $500.00, and in default of payment to imprisonment for a period not exceeding three months.

For obstructing a Game Guardian in the discharge of his duties, the penalty is a sum not exceeding $100.00 and costs.

For violation of any of the provisions of the Ordinance with regard to musk-oxen, buffalo or bison, elk, wapiti, moose or deer, a penalty of not more than $500.00 and costs.

For a violation of any other provisions of the Ordinance a penalty not exceeding $100.00 and costs.

In case of a conviction one-half of the fine shall be paid to the informer.

APPENDICES

APPENDIX 1

An Ordinance regulating the Exportation of Foxes

1. This Ordinance may be cited as *The Fox Protection Ordinance.*

INTERPRETATION

2. In this Ordinance the following expressions have the meaning assigned to them in this Section unless the context otherwise requires:

(*a*) The word " person " or " party " shall include any person or party, persons or parties or any body corporate or politic, partnership, company or society and the heirs, executors, administrators or other legal representatives of such persons to whom or which the context is capable of applying.

(*b*) The word " penalty " with reference to an offence under this Ordinance includes any fine to which the offender may be liable under this Ordinance and also any imprisonment which under the provisions hereof may be imposed in default of the payment or satisfaction of such fine and also to all forfeitures provided for under the provisions of this Ordinance.

3. No one shall hunt, take, kill, shoot at, wound, injure or molest in any way between the first day of April and the first day of June any fox under one year of age.

4. Every person who at the date of the coming into force of this Ordinance is the owner of any live fox or foxes in captivity within the Yukon Territory shall not later than two months thereafter file with the Territorial Secretary at Dawson or some person at Whitehorse to be appointed by the Commissioner a statement in writing under oath containing the name of the owner thereof and the number of foxes owned by him with a description of each of such foxes and such person shall thereupon be entitled to a permit from the Commissioner or some person appointed by him for the purpose at Whitehorse authorizing such person to export and ship such foxes to any place without the Territory.

5. No person, corporation, railway company, express company or other common carrier shall at any time or in any manner export or cause to be exported or carried or have in possession for the purpose of exporting or carrying out of the limits of this Territory any live fox not born in captivity or any other live fox which has not been in captivity for a period of at least two years, but no live foxes of any kind shall be exported from the Territory except in pursuance and by virtue of a permit from the Commissioner or some person at Whitehorse to be appointed by the Commissioner for that purpose.

6. Before any permit for exporting any live fox is granted there shall be filed with the person issuing such permit a statutory declaration by the owner of such fox or his agent that such fox has either been born in captivity or has been in captivity for at least two years. Such declaration to specify the kind and colour of each fox to be exported. The fee for each permit issued shall be $5.

7. Every person, corporation, railway company, express company, or other common carrier shall, on production of such permit by the holder thereof, be entitled to carry without the Territory the foxes in such permit described. Such permit to be taken up by them and forwarded to the Territorial Secretary.

8. Every one is guilty of an offence and liable to the penalty hereinafter provided who at any time hereafter in any part of the Territory, without the consent of the owner or caretaker of a ranch or enclosure where foxes or other fur-bearing animals are kept in captivity for breeding purposes, shall approach or enter upon the private grounds of the owner or owners of the said animals within a distance of twenty-five yards from the outer fence or enclosure within which the pens or dens of the said animals are located and upon which said fence notice forbidding trespassing on the said premises is kept posted so as to be plainly discernible at the said distance of not less than twenty-five yards, provided a public highway does not run closer than twenty-five yards.

PENALTIES

9. Every person who violates any of the provisions of this Ordinance is liable on summary conviction thereof to a penalty as follows:—

(*a*) Any person who commits an offence under or against the provisions of Section 5 of this Ordinance to a penalty of not less than $50 and not exceeding $300 and in default of payment or satisfaction, to suffer imprisonment for a period not exceeding six months, with or without hard labour.

(*b*) Any person who commits an offence under or against the provisions of Section 3 or Section 8 of this Ordinance to a penalty of not less than $10 and not exceeding $100 and in default of payment or satisfaction to suffer imprisonment for a period not exceeding three months, with or without hard labour.

(*c*) In addition to the penalty provided in subsections "*a*" and "*b*" hereof, all foxes found being exported or shipped from the Territory or which have been taken within the prohibited period in violation of the provisions of Sections 3 and 5 of this Ordinance, shall, on conviction of any person so taking, exporting or shipping the same, be forfeited to and become the property of the Yukon Government.

10. Every fee, fine or penalty recovered under this Ordinance shall be paid into the office of the Territorial Treasurer.

11. All fines, penalties, fees and moneys recovered or paid under any of the provisions of this Ordinance shall form part of the general revenue fund of the Territory.

CHAPTER 5 OF THE ORDINANCES OF THE YUKON TERRITORY 1915

AN ORDINANCE TO AMEND THE FOX PROTECTION ORDINANCE, BEING CHAPTER 38 OF THE CONSOLIDATED ORDINANCES, 1914.

(Assented to April 15th, 1915.)

The Commissioner of the Yukon Territory, by and with the advice and consent of the Council of said Territory, enacts as follows:—

1. Section 5 of Chapter 38 of the Consolidated Ordinances of the Yukon Territory, 1914, is hereby amended by inserting the word " or " after the words " Person " and " Company " in the first line of said Section and by striking out all the words after the word " fox " in the fifth line and substituting in lieu thereof the words " or foxes not born in captivity which has or have not been in captivity for a period of at least one year, but any fox or foxes born in captivity may be exported at any time upon the exporter thereof complying with the provisions of the said Ordinance."

2. Subsection (*a*) of Section 9 of said Ordinance is amended by striking out the words and figures " than $50 and not exceeding $300 " in the third line thereof and substituting in lieu thereof the following words and figures " than $50 and not exceeding $100 for each cross fox and not less than $150 and not exceeding $300 for each silver or black fox."

APPENDIX 2

PASSENGERS

	1st class	2nd class
Northbound		
Vancouver, Victoria, B.C., Seattle, Tacoma, Wash. to		
Whitehorse, Y.T.	$50.00	$40.00
Dawson, Y.T.	80.00	65.00
Skagway, Alaska, to Whitehorse, Y.T.	20.00	20.00
Skagway, Alaska, to Dawson, Y.T.	50.00	45.00
Whitehorse, Y.T., to Dawson, Y.T.	30.00	25.00
Southbound		
Dawson, Y.T., to Whitehorse, Y.T.	50.00	40.00
Dawson, Y.T., to Skagway, Alaska	70.00	60.00
Whitehorse, Y.T., to Skagway, Alaska	20.00	20.00
Whitehorse, Y.T., to Vancouver, etc., as above	50.00	40.00
Dawson, Y.T., to Vancouver, etc., as above	100.00	80.00

For the local travel on the Yukon river in Yukon Territory, the passenger rate down-stream is based on, approximately, seven cents per mile, and up-stream eleven cents per mile. When the fare exceeds ten dollars berths and meals are furnished free on the rate charged.

Meals, when not included in fare $1.00
Berths, when not included in fare, per night $1.00
Children, from 5 years to 12 years of age, half fare.
The purchase of round-trip tickets allows 10% reduction on local traffic.
150 lbs. baggage free with each full ticket.
Baby carriages, bicycles, and dogs are carried as excess baggage at estimated weight of 50 lbs. each.
Baggage is limited in valuation to $100 for 150 lbs.
If any excess valuation is declared an additional charge will be made on such excess.
Excess baggage rate between Whitehorse and Dawson is 6 cents per lb.

JOINT ROUND-TRIP—PASSENGER RATES

	Rate	Days limit	Final limit
From Skagway, Alaska, to Atlin, B.C. (includes also round-trip, Caribou to Whitehorse and return)	$40.00	20	Oct. 10th
Whitehorse, Y.T	32.00	15	All year
Dawson, Y.T.	100.00	30	Sept. 15th
Fairbanks, Alaska	190.00	45	Sept. 15th
Ft. Yukon, Alaska	140.00	45	Sept. 15th
Nome, Alaska, and return to Seattle, Wash., by ocean	195.00	.....	.....

Side Trips.—Holders of tickets as above have privileges of making side trips from the direct line of travel, at the following added expense.

Caribou, Y.T., to Atlin, B.C., and return	$15.00
Tanana, Alaska, to Fairbanks, and return	40.00
Holy Cross, Alaska, to Dikeman, Ala., and return	40.00

Freight

Class rates from British Columbia and Puget Sound points, to Dawson City, Y.T., in dollars per ton.

	A		B		C	
	C.L.	L.C.L.	C.L.	L.C.L.	C.L.	L.C.L.
1900	$125.00	$125.00	$125.00	$125.00	$125.00	$125.00
1915	57.00	62.00	66.00	76.75	81.00	90.75

1900	Cattle, $39.75, Skagway to Dawson.
1915	Cattle, $20.00, Skagway to Dawson.

COMMODITY RATES

Straight carload lots of 20,000 pounds or over in dollars per ton.

From British Columbia and Puget sound points to	Dawson	Whitehorse
Beer, bottled, C.L.	$47.00	.....
Coal, blacksmith, C.L.	38.50	.....
Coal oil, C.L.	47.00	.....
Feed, chopped or ground, C.L.	42.00	.....
Flour, C.L.	40.00	.....
Hay, double compressed, min., 14,000 lbs.	46.00	.....
Lath and shingles, C.L.	49.75	.....
Liquors (Alcoholic), C.L.	53.00	.....
Lumber, rough, including dredge timbers, shaped and painted, under 40 ft. in length	$53.00 per 1,000	$38.00 all Y.
Lumber, dressed or T. & G.C.L.	71.00 ft. B.B.	45.00
Milk and cream, canned, C.L.	$41.00	.....
Nails, C.L.	47.00	.....
Oats, C.L.	42.00	.....
Sugar, common, C.L.	40.50	.....
Foregoing rates become effective June 15th and expire August 15th, subject to change.		
Hay, single compressed, C.L.	69.75	.....
Oil, crude	55.00	.....
Onions, C.L.	64.00	.....
Potatoes, common	64.00	.....
Mining machinery, C.L.	44.90	$42.00 all Y.
Mining machinery, L.C.L.	49.75	51.00 all Y.
The latter group is effective during open navigation. Heavy pieces of mining machinery, over two tons each up to twenty tons each, take advanced rate of from $2.25 to $17.25 per ton, to cover extra expense of handling.		

When the foregoing commodity rates are effective to Dawson, the same rate would apply to Whitehorse business of the same commodity, unless local rates are lower.

APPENDIX 3

Rates

The Company reserves the right to refuse any and all business during time when trail conditions makes overland operations extremely difficult. At such times the carrying of mail takes precedence.

PASSENGERS

Northbound—Whitehorse to Dawson

From close of navigation to December 1st	$100.00
From December 1st to March 15th	80.00
From March 16th to April 15th	100.00
From April 15th to end of season	125.00

Southbound—Dawson to Whitehorse

From close of navigation to December 1st	$100.00
From December 1st to March 31st	75.00
From April 1st to April 15th	100.00
From April 16th to end of season	125.00

The above dates and limitations apply from the starting point of stage line—Whitehorse to Dawson.

Local Rates on Stage Line

When the through rate is $75.00, rate per post $5.00.
When the through rate is 80.00, rate per post 6.00.
When the through rate is 100.00, rate per post 7.00.
When the through rate is 125.00, rate per post 9.00.
Meals at road houses, $1.50.
Beds at road houses, $1.00 per night.
Free baggage allowance, 25 lbs.
Excess baggage rate, 25 cents per lb.

FREIGHT

When trail conditions are good the rate between Whitehorse and Dawson is from 15 cents to 18 cents per lb., according to compactness of goods. Large quantities are contracted at somewhat lower rates, when conditions are good. When conditions are unfavourable all freight is handled on special contract.

APPENDIX 4

RETAIL PRICES AT DAWSON

	Summer		Winter	
Eggs (Over the ice)			Doz.	$1.00
Eggs, summer and fall shipments	2 doz.	$1.25	Doz.	.75
Eggs, Dawson ranch	Doz.	1.50	Doz.	2.50
Butter, dry packed and pickled	Lb.	.45	Lb.	.50
Butter, canned	2 lbs.	1.25	2 lbs.	1.25
Cheese	3 lbs.	1.00	Lb.	.50
Sugar	Lb.	.10	8 lbs.	1.00
Cream, hotel size	3 tins	1.00	3 tins	1.00
Milk, reindeer	5 tins	1.00	Tin	.25
Tobacco, T. & B. smoking	Lb.	1.00	Lb.	1.00
Flour, hard	50 lb. sack	3.50	50 lb. sack	3.75
Flour, soft	50 lb. sack	3.50	50 lb. sack	3.75
Rolled oats	7 lb. sack	.75	7 lb. sack	.75
Corn meal	10 lb. sack	.75	10 lb. sack	1.00
Cream of wheat	3 packages	1.00	Package	.50
Corn starch	5 packages	1.00	Package	.25
Maple syrup, Canadian	½ gallon	1.25	½ gallon	1.25
Rice	Lb.	.10	8 lbs.	1.00
Lima beans	Lb.	12½	Lb.	.15
Potatoes (Imported)	Lb.	.08	Lb.	.10
Potatoes (Native)	Lb.	.05	Lb.	.06
Onions	Lb.	.10	Lb.	12½
Canned fruits, Canadian, 2 lb. tins	3 tins	1.00	3 tins	1.00
Canned fruits, American, 3 lb. tins	3 tins	1.25	Tin	.50
Dried fruits	Lb.	.25	3 lbs.	1.00
Canned peas, corn and beans	Tin	.25	Tin	.25
Canned tomatoes	Tin	.25	3 tins	1.00
Tomatoes, fresh	3 lbs.	1.00		
Oysters, B. P., 2 lb. tins	2 tins	1.75	Tin	.75
Salmon, canned	Tin	.25	Tin	.25
Lobsters, canned, medium size	Tin	.50	2 tins	1.25
Chicken and turkey, canned	Tin	.50	Tin	.50
Ham	Lb.	.35	Lb.	.40
Bacon	Lb.	42½	Lb.	.45
Lard	Lb.	.25	Lb.	.25
Soap, Lennox	10 bars	1.00	10 bars	1.00
Soap, Ivory	6 bars	1.00	6 bars	1.00
Coffee	2 lbs.	1.25	1 lb.	.75
Tea	Lb.	.75	Lb.	.75
Coal oil	5 gallon can	3.00	5 gallon can	3.50

APPENDIX 5

FEDERAL OFFICIALS

(Heads of Departments)

George Black, Commissioner of Yukon Territory.
G. A. Jeckell, Comptroller.
John Black, Legal Adviser and Public Administrator.
G. P. Mackenzie, Gold Commissioner and Crown Timber and Land Agent.
R. C. Miller, Assistant Gold Commissioner, Whitehorse.
J. H. Brownlee, D.L.S., Director of Surveys.
Albert E. Lamb, B.A., LL.B., Registrar.
Alexander McCarter, Postmaster.
E. S. Ironside, Collector of Customs.
Ernest Rivard, Agent Department of Public Works.
G. S. Fleming, Superintendent Government Telegraphs, Whitehorse, Y.T.
Rev. John Hawksley, Indian Superintendent.
Joseph Stingle, Collector of Inland Revenue.
L. R. MacLennan, Mining Recorder, Duncan Mining District.
Wm. Schofield, Mining Recorder, Sixtymile Mining District.
Archibald McLean, Mining Recorder, Conrad Mining District.
A. D. McLennan, Mining Recorder, Kluane Mining District.
G. F. Curran, Mining Recorder, Whitehorse.

ROYAL NORTH-WEST MOUNTED POLICE

J. D. Moodie, Superintendent commanding "B" Division, R.N.W.M.P.
E. Telford, Inspector, Dawson.
A. L. Bell, Inspector, Whitehorse.

TERRITORIAL COURT, YUKON TERRITORY

Hon. C. D. Macaulay, Judge.
George Brimston, Sheriff.
John Black, Clerk of Territorial Court.
J. Langlois Bell, Police Magistrate at Whitehorse.

ADMIRALTY COURT, YUKON TERRITORY

Hon. C. D. Macaulay, Judge.
John Black, Registrar.

MEMBERS OF YUKON COUNCIL

(Elected in March, 1915)

Name	Electoral District
William J. O'Brien	North Dawson
J. P. Guite	North Dawson
N. A. Watt	South Dawson
Wm. G. Radford	South Dawson
G. N. Williams	Bonanza
John Turner	Bonanza
A. N. McK. Martin	Klondike
John McKrimmon	Klondike
E. A. Dixon	Whitehorse
W. L. Phelps	Whitehorse
A. F. Engelhardt, Clerk of the Council	.....

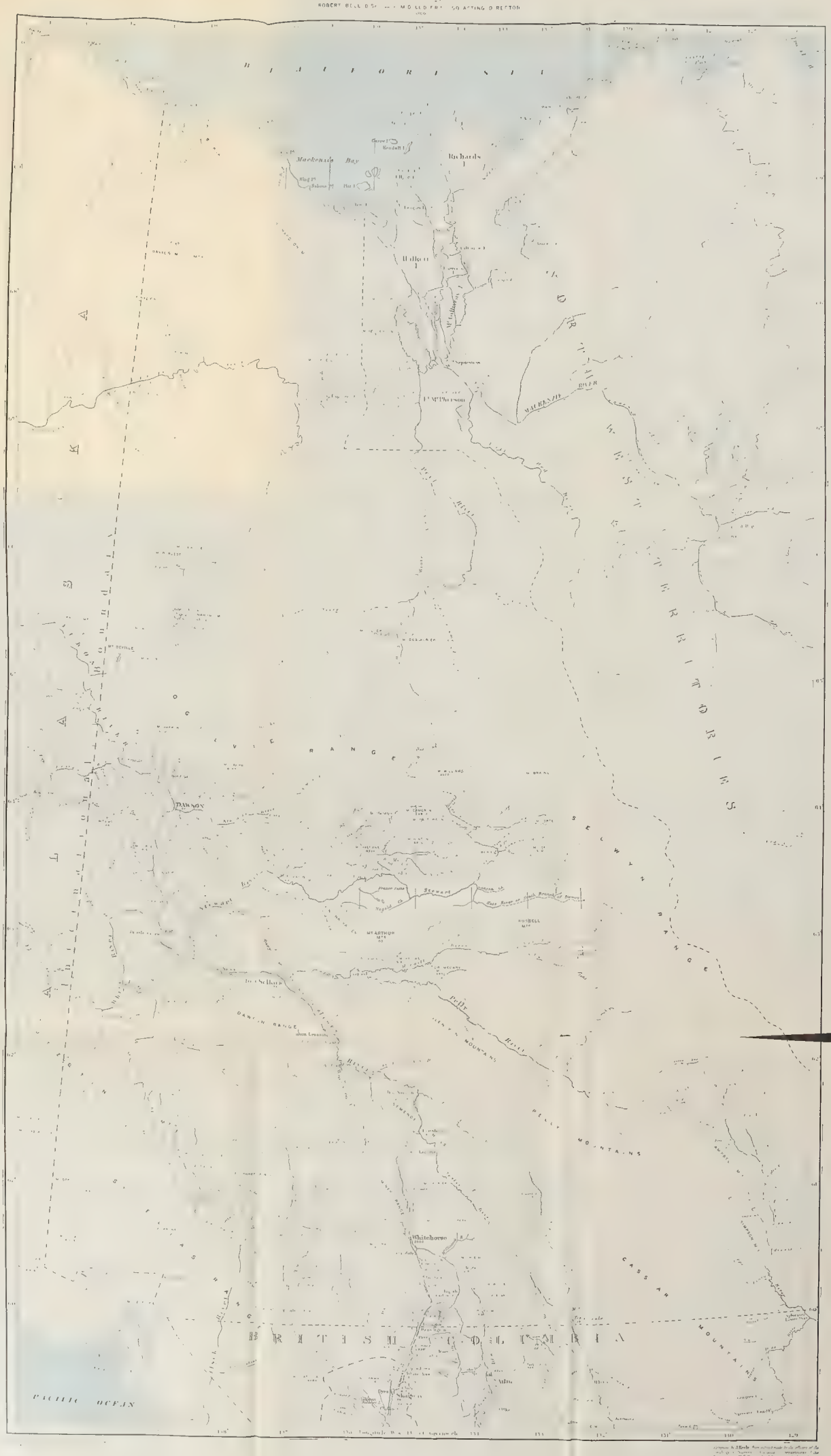
TERRITORIAL OFFICIALS

(Heads of Departments)

A. F. Engelhardt, Territorial Secretary and Treasurer.
Isaac Lusk, Superintendent of Works and Buildings.
T. G. Bragg, B.A., Superintendent of Schools.
William Sime, Territorial Assayer.
W. W. Chapman, M.D., Medical Health Officer.

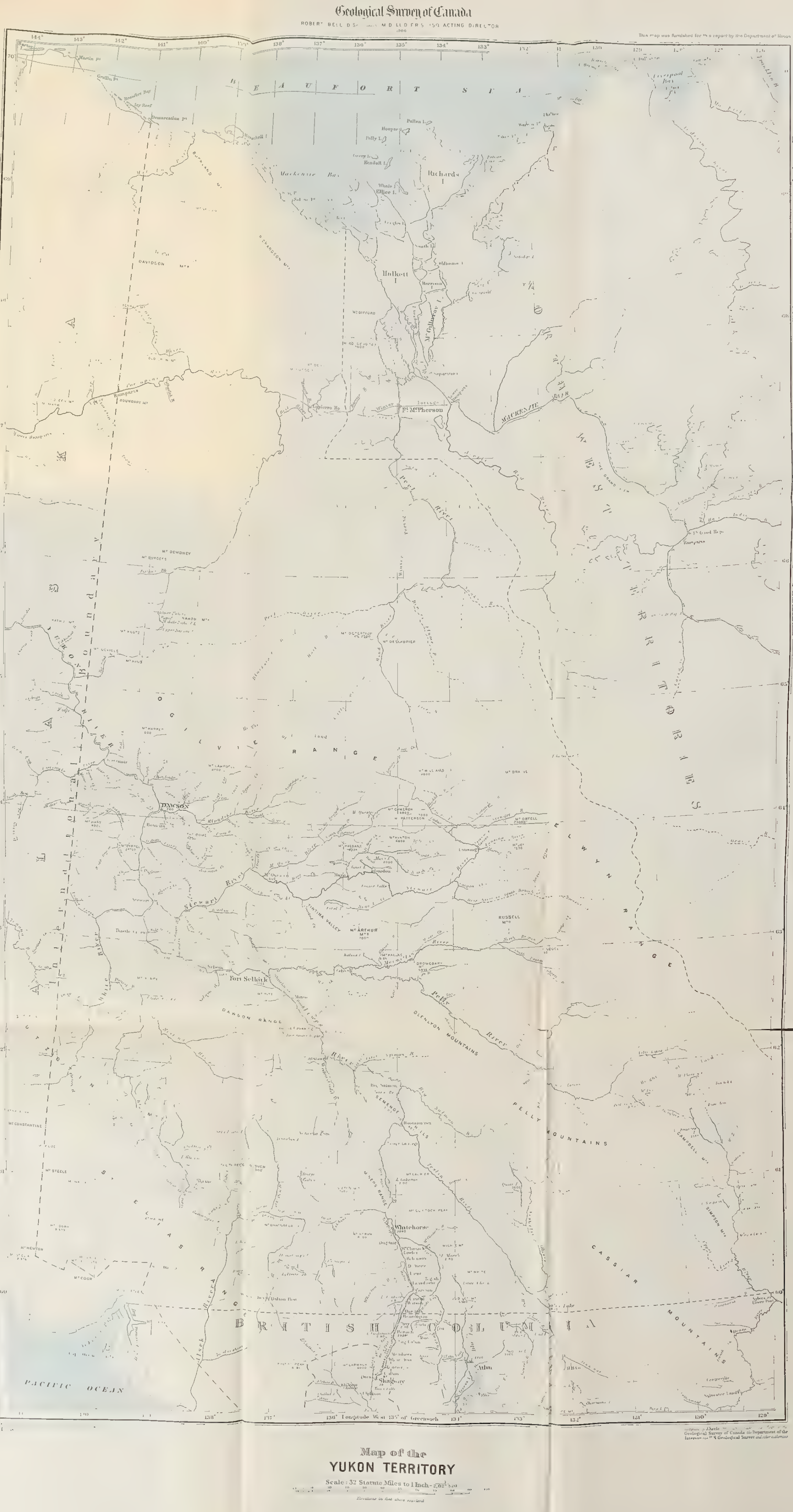
Geological Survey of Canada

ROBERT BELL D.Sc. — M. DAWSON, B.A. — ACTING DIRECTOR



Map of the
YUKON TERRITORY

Scale 25 Statute Miles to 1 Inch = 1584000



Geological Survey of Canada
1900
BEAUFORT SEA
PACIFIC OCEAN
BRITISH COLUMBIA
ALASKA
N.W. TERRITORIES
International Boundary
OGILVIE RANGE
SELWYN RANGE
PELLY MOUNTAINS
CASSIAR MOUNTAINS
GLENLYON MOUNTAINS
DAWSON RANGE
ST. ELIAS RANGE
Dawson
Fort Selkirk
Whitehorse
Ft. McPherson
Skagway
Atlin
Richards I.
Halkett
Martin pt.
Griffin pt.
Demarcation pt.
Mackenzie Bay
Herschel I.
Peel River
Pelly River
Stewart River
White River
Mackenzie River
Longitude West 135° of Greenwich
Map of the
YUKON TERRITORY
Scale: 32 Statute Miles to 1 Inch

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